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The Welsh Engineers' and Founders' Association

The Foundry Trades' Equipment and Supplies Association

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In Smaller Mould

Very shortly, owing to the Paper shortage, the FOUNDRY TRADE JOURNAL, in common with all other publications, has to cut its consumption of Paper to 19.5 per cent. of the pre-war amount. The avenues open to publishers are that they can either print fewer copies or reduce the size of the publication, or a combination of the two so as to reduce the paper consumption to a fixed percentage of a specified pre-war average. The proprietors of the Journal have decided to reduce its size and maintain its circulation. The free list, never very extensive, has been for some time entirely eliminated, and now every copy is paid for. The only Journals which will be in a position to maintain pre-war size in the future will be those which had such an extensive free list, that they, merely by eliminating this, can still operate within the very extensive cuts made by the Paper Control. Thus those Journals with a negligible free list are suffering a relatively greater reduction. It will come as a surprise to many of our readers that in pre-war days 47 per cent. of the circulation was foreign, and in spite of the closing of all the European and many of the Far Eastern markets, it is still 26 per cent.

It is a little distressing for us to have to announce this change in format at this moment, as we feel that the high-grade technical Press should be accorded treatment more favourable than that which is meted out to the modern counterpart of Ally Slopers Weekly. This will be the fourth change in format since the birth of the Journal in 1902. A monthly, it was then much of the size it will temporarily assume in the future. When within a few months of its birth, it was bought by the present proprietors, a change was made to a larger size, carrying two columns. This remained unaltered until January, 1921, when the Journal became a weekly newspaper, and the columns were lengthened. By October, 1927, the volume of technical matter had grown to such proportions that means had to be found for its presentation without undue delay, and the present popular three-column style was adopted. This allowed us to produce in much detail the layout plans of the mechanised foundry, then coming into vogue. Special issues were produced at frequent intervals, which enabled us to publish each year about 2,658 columns.

The difficulties confronting us to give a comparable service on a reduced scale will be fully overcome. We have made plans of such a character that we believe we can retain the whole of the features to which our readers have become accustomed. If certain matters are eliminated or over condensed, which readers would like to be restored or amplified, we shall be glad to have their criticism. These will receive the most careful consideration, and where the volume of opinion is sufficiently imposing, restoration or amplification will be made. We ask indulgence from authors and contributors if they find editing and cutting a little more severe than was our practice. We have no intention of becoming a review, as the metallurgical and foundry world expects from us a full presentation of technical Papers, and their subsequent discussion. For the purposes of binding, recording and filing, we have decided to start a new volume number—sixty-seven. It is a matter for some congratulation that up to now after two and half years of war we have been able to maintain the Journal at its pre-war level. The many appreciative letters we have received, especially from America, have been encouraging to us, and as we reflect the technical activity of the foundry world, they must also be regarded with satisfaction by the technicians of the industry.

There is one aspect of our work which will be unaffected by the change, and that is the service we render to readers through our information bureau. With the constant changes in the conditions of manufacturing, many queries arise, and we are convinced that our service, given alike to the Government departments down to the humblest member of our industry, is a particularly high order, and its usefulness is being increasingly recognised. It is not that our knowledge is encyclopædic, but rather do we act as a clearing house, as we usually know where the information is to be obtained.

This change-over must be regarded as being merely of a temporary character, and immediately conditions permit the Journal will be restored to its present size, or an improved equivalent. To our advertisers we express our sincere thanks for the co-operation they have accorded our colleagues in the difficult job to be associated with preparation of their material to appear on the reduced scale.

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Electrically-Heated Salt-Bath Furnace

"Electrothermic-permeation" is claimed to improve a new internally-heated electric salt-bath furnace for any heating operation requiring temperatures between 300 and 2,500 deg. F. More uniform heat, reduced fuel costs, lower consumption of carburising salts and a ceramic pot guaranteed for at least one year's operation are features of the furnace, state the makers, the Upton Electric Furnace Company, of Detroit. Units are designed for the carburising, cyaniding, hardening of molybdenum and tungsten high-speed steels, selective hardening, brazing, heating for forging, treating aluminium alloys, tool tipping, etc., for either batch or continuous operation.

According to the electrothermic-permeation principle, the heat for the bath is generated throughout all the effective working space. Electrodes are installed outside of the normal working area in opposite corners, but are so inclined that their lower ends tend to converge. The resulting concentration of current generates the greater amount of heat at the bottom of the pot, thus creating active thermal circulation throughout the entire bath. Since the electrodes are inclined outward, the amount of heat generated decreases toward the top of the pot, because of the increasing distance between the electrodes. This diminishing value of current creates a carefully distributed volume of heat for maximum uniformity of heating.

Approximately 80 per cent. of the heat is generated at the bottom of the pot, where the electrode ends are close together. In the design, there is nothing that endeavours to force the circulation of heated salt against its natural upward movement. This, together with wide electrode spacing, eliminates the possibility of "super-heated" areas which hasten the deterioration of carburising salts especially, so insuring more evenly distributed temperature.

Ceramic brick pots are standard. This type increases pot life to such an extent that the company guarantees them for one year even on high-speed steel and similar work requiring extreme temperatures. Two styles are furnished. The high-temperature type has an inner lining of special alloy steel insulated on both sides, with the interior of the pot itself being lined with two kinds of ceramic brick to withstand abrasion, thermal shock and corrosion, respectively.

The low-temperature pot, also guaranteed for at least one year, follows the same general design, but does not require the special alloy lining. Both types are built with the walls at such an angle as to best withstand the effects of expansion and contraction due to the range of temperatures involved.

The high thermal efficiency improves working conditions. Water-cooled electrode busbars and connectors provide improved conductivity and are so designed that the time required for electrode replacement does not exceed 5 min.—"Steel."

Iron and Steel Control Changes

The Ministry of Supply announces that Mr. W. F. Prentice, Director of Shell Steel Production, Iron and Steel Control, will in future also supervise heavy steel products, and has been accordingly appointed Director of Heavy Steel Products and Shell Steel. Mr. R. Colin Smith has been appointed Deputy Director of the Heavy Steel Products and Shell Steel Department. Major E. W. Senior, Director of Alloy Steels, Iron and Steel Control, will now also be responsible for armour-piercing shot. In the deputy controller's department, Mr. Kenneth Lampson has been appointed Personal Assistant to Mr. J. M. Duncanson, Deputy Controller in charge of Iron and Steel Supplies.

Notes from the Branches

Middlesbrough and District Branch.—The Annual General Meeting was held in the Cleveland Technical Institute, Middlesbrough, on March 20, Mr. O. G. Wilson presiding. Mr. J. K. Smithson (Hon. Secretary) reported that a normal programme of meetings had been carried out with somewhat varying success, but on the whole attendances had been sufficient to warrant continuing to arrange meetings. Membership of the Branch had been well maintained, if not actually increased.

Election of Officers.—Mr. Frank Swift was unanimously elected Branch-President for the ensuing year. Mr. G. O. Stanley and Mr. H. Foster were elected Senior and Junior Vice-Presidents respectively. Mr. W. Siddle and Mr. S. Leetch were re-elected members of Council, and Mr. S. N. Wrightson, Mr. G. K. Walters, and Mr. S. E. Dowson were elected members of Council to fill other vacancies. Mr. J. E. Mercer was elected representative to General Council, and together with Mr. S. Leetch to the Technical Council. Both these gentlemen were warmly commended and thanked for their excellent services to the Branch during their preceding term of office. Mr. O. G. Wilson was elected Reception Officer, and Mr. J. H. D. Hobson and Mr. H. Foster were re-elected Hon. Auditors.

In moving the re-election of Mr. J. K. Smithson as Hon. Secretary, MR. J. E. MERCER proposed that a hearty vote of thanks be accorded to the Secretary for his services during the year, and his motion was carried with acclamation.

At the close of the formal business, MR. WILSON inducted the incoming Branch-President to the chair. He observed that this was the first occasion upon which a Darlington man had presided over the Branch, and that it was most fitting that Mr. Swift should have this distinction in view of his enthusiastic services on the Branch Council, and the number of most instructive and practical contributions he had made to this and other branches in the form of Papers and in other ways. Taking the chair, MR. SWIFT proposed a vote of thanks to the retiring President, which was heartily accorded.

Lancashire Branch.—The next meeting of the Branch has been postponed to April 11, when Mr. W. Braidwood will present his Paper, "Experiences in the Production of Cupola-Melted High-Duty Cast Iron." The Paper will be preceded by the annual general meeting at 3 p.m.

Absenteeism an Offence

Absenteeism and persistent lateness in industry are dealt with in a new Order, made by the Minister of Labour and National Service, which comes into force to-day (Thursday), and which amends the Essential Work (General Provisions) Order, 1942. Hitherto absence or persistent lateness on the part of workers in scheduled undertakings has not been a direct offence under the Defence Regulations. The Essential Work Order provided that such cases could be reported to the National Service Officer, who, after investigation, could give the worker concerned a direction as to the method or manner of his work, and the times at which and during which he should present himself for work and remain at work. The worker had the right of appeal to a local Appeal Board against any direction. Failure to comply with the direction constituted an offence under the Defence Regulations.

This procedure has been found to be too cumbrous. The amending Order makes it an offence for a person to whom the Essential Work Order applies either to absent himself from work or be persistently late without reasonable excuse. Proceedings can be taken against an offender without the National Service Officer having to give a specific direction to the person concerned and without him having an opportunity to appeal. Where, however, there is in the undertaking a works committee, or

(*Continued in next column.*)

Random Shots

The lamentable ignorance of the man-in-the-street on foundry matters has often been remarked upon in this column and an illustrated page in a popular national weekly provides ample proof of this. It proves, moreover, that this ignorance is not merely lamentable but abysmal. The illustration of the charging of a cupola is explained as scrap being fed into the basic steel blast furnace at a temperature of 1,600 deg. C., whilst a picture of the filling of a mould with its product is described as molten steel that once was iron girders being poured into heavy moulds. Later on, explains the captionist, the metal will be transformed into solid steel ingots! The idea was undoubtedly a good one and all went well until the captionist got busy. The worst of it is that the uninitiated will probably believe every word of it, for reverence for the printed word is instilled deep in the British breast. Incidentally, even a member of the staff of the Ministry of Information had to ring up the Ministry of Supply to ask "what exactly *is* a foundry?"

* * *

The new Order for simpler clothes has contrived to make men clothes-conscious, and for the first time in their lives they are beginning to take an interest in how their suits are constructed. Every morning for fifty years (can it be so long since a fellow was breeched?), the average middle-aged man has put on the same invariable order of dress: vest, pants, shirt and suit, without ever a thought of the number of buttons he has to fasten, for instance. It is calculated that a complete outfit involves a fastening of at least twenty buttons, and that is six less than the tailor has had to stitch on. Add to that an overcoat with about four fastening buttons and nine more permanent fixtures, and one can readily understand why in this high-speed age buttoned boots and spats have gone out of fashion, although so much favoured as essential equipment by Herr Teufelsdröckh, the classical philosopher of clothes and erudite Professor of all things in general at the University of Weissnichtwo.

* * *

The new utility clothes may mean an extra two minutes in bed for the incurably late riser, but there is still something to be said in favour of wearing old clothes. It was not long ago, for instance, that the chairman of a foundry in Yorkshire, who is also a past-president of the Institute of British Foundrymen and an M.P., was offered tuppence by the driver of a car who mistook him for a labourer. He had put on a very old suit to do a practical job of engineering in the works, had got very dirty in the process, and was just leaving the premises when a car drove up behind him. Naturally he held the gate open for the car to pass through. He records with delight that he pocketed that tuppence with pride.

* * *

The answers to last week's quiz are as follow:—Cryst (all)—in crystallography; E. midl.—East Midland; Jam—Jamieson's Scottish Dictionary; M.Sc.—Middle Scottish; N.O.—Natural Order; Pron—Pronounced; *Pron*—Pronoun; S.A.—Milton's Samson Agonistes.

"MARKSMAN."

(*Concluded from previous column.*)

other joint council, which, in the opinion of the National Service Officer, can appropriately deal with the matter, the case must be referred to that body.

A similar amendment is being made in the Order relating to the building and civil engineering industries. The question of amendments to other Orders relating to special industries will be further discussed with the industries concerned.

Liquid Steel Temperatures—II

RECENT WORK WITH QUICK IMMERSION THERMOCOUPLES IN SHEFFIELD STEELWORKS

Section II of the Third Report of the Liquid Steel Temperature Sub-Committee of the Committee on the Heterogeneity of Steel Ingots of the Iron and Steel Institute deals with "Recent Work with the Quick-Immersion Thermocouple in the Steelworks of Sheffield," by Dr. F. H. Schofield. Part I was summarised in the "Foundry Trade Journal" of March 19.

Of the three parts, Part A deals with a number of suggested improvements in the mounting of thermocouples for employment in open-hearth, arc and high-frequency furnaces, and a few points connected with their use. Part B deals with special applications of the instrument—for example, (*a*) determining the temperature distribution in large and small arc furnaces; (*b*) the comparison of the thermocouple and an optical pyrometer on an open-hearth furnace, showing that only during the boil does the latter give even approximately the temperature of the steel; (*c*) the determination, by means of the thermocouple, of the accuracy of two types of optical pyrometer when sighted on a stream of steel, namely, the disappearing-filament pyrometer and a new "colour" pyrometer, in which the inferiority of the latter is clearly established; and (*d*) measurements in the trough, showing the remarkable constancy in temperature of the outflowing metal during the half-hour required for the casting from a 25-ton ladle. In Part C the position at several works with regard to the exercise of temperature control, on the basis of the thermocouple, is dealt with, showing that a definite routine is now in operation in many of the smaller furnaces, and that good results have already been obtained in some of the larger.

The instrument used remains essentially unchanged, but a number of modifications have been made with a view to rendering it more readily operable. Examples of these are given below, arranged according to the use to which the instrument is to be put.

Apparatus for Large Furnaces (Open-Hearth and Arc)

Of the two designs originally described, that intended for operation by the furnace charger has been discontinued, as has also the use of the thin steel sheath covering the silica tube. The reason for the latter decision is that, in the absence of the steel sheath, the silica tube is found to perform its function of protecting the couple for a single immersion in steel both in acid and in basic furnaces—in fact, two immersions can occasionally be obtained in a basic slag.

In all the designs employed in the works having representatives on the Sub-Committee the arrangement of the silica insulation and the silica sheath, on which the speed of response of the instrument primarily depends, have been retained. The other outstanding features of these designs are tabulated in Table I. The following comments may be added.

End Block (Table I, Column 3).—In the original design the silica sheath was wedged into a block of "Fosalsil," 3 by 3 by 9 in., which served to protect the steel end piece from contact with the liquid steel and slag. It will be seen that this practice has been followed in five cases. The method of attachment of the block by screwing it to the end piece has also been retained, except in the case of *J* where the block, which is only 4½ in. deep, has been attached by a push fit. Incidentally, it may be remarked that the length of block is governed by the depth of slag and the desired length of immersion in the steel, and that the block, as manufactured, has a standard length of 9 in.

With regard to the remainder of column 3, it will be seen that the *US*(*c*) works have used the "Non-pareil" block made by Newalls, Limited, which is a diatomaceous product similar to the Fosalsil of Moler Products, Limited, and have also used a carbon block. The latter is a particularly interesting development. The block is turned down from waste electrode material. It has the property of not being wetted by either acid or basic slags and has an exceptionally long life. Thus, one block has had 33 immersions (30 basic and 3 acid) without noticeable deterioration. A further advantage claimed for the carbon block is that its screw thread is stronger than that in the diatomaceous material. On the other hand, the high density and thermal conductivity of the carbon may be disadvantageous in some respects.

Indicator, Thermocouple and Leads, Main Tube (*Table I, columns* 4 *to* 9).—These details of design are inter-related and depend to a considerable extent on whether the apparatus is intended to be used with a millivoltmeter or a potentiometer. For the former instrument, it is essential that the circuit resistance should remain sensibly constant, and this, with long wires traversing the high-temperature zone, requires careful attention to design. For example, the use of 0.3-mm. couple wire for the whole length of the hot region could not be tolerated with a millivoltmeter, for the resistance of the couple would be of the order of 6 to 8 ohms and the changes of this resistance with varying temperature would produce considerable errors on an instrument of 200 to 300 ohms resistance. In the case of 0.3-mm. wire, therefore, a potentiometer should be used.

With regard to column 6, it will be noted that in every example the precaution is taken of using compensating leads to transfer the cold junction to the indicator. Should this latter be a millivoltmeter, a further obvious precaution, in view of the wide variations of air temperature near a furnace, is to employ one of the well-known devices for automatic cold-junction compensation. Such compensation is not so readily applied to a potentiometer, but if the instrument is of the slide-wire type a movable index may be used to make the necessary cold-junction correction. A device of this kind is employed by Hadfields, Limited.

The following comments may be added on the individual designs:—

H follows the original design with, however, some special features. For example, the great length (17 ft.) of the main tube, which is a hydraulic pipe, gives good control and obviates the necessity of a protection shield for the operator. In view of the comparatively low resistance (300 ohms) of the portable millivoltmeters available, special attention is given to the design of the thermocouple and its compensating leads, the total resistance of which amounts to 1.5 ohms. A considerable rise in the temperature of the thermocouple must take place in such a circuit before an excessive error arises in the indicated temperature. The thermocouple unit, contained in the upright tube, is readily removable, a single screw serving to fix it and make connection to the terminal plates of the compensating leads. Correct assembly of the unit is obtained by means of a special holder and gauge.

FB also follows the original design closely, differing mainly from it in that the couple extends to the part of the apparatus outside the furnace.

In the case of *ESC*, a bare tube of heat-resisting steel (20/25 nickel-chromium) is used for the main part of the apparatus. The complete instrument weighs 80 lbs., of which the tube assembly accounts for 20 lbs. For very erosive slags, the device of coating the block with a wash of alumina, which was mentioned in the last Report, adds considerably to its life, or the carbon block described above may be used.

J is a light apparatus weighing 13 lbs., having a fairly short main tube insulated towards its hot end with a special cement consisting of 49 per cent. of Fosalsil plastic compound, 49 per cent. of crushed firebrick (8-mesh) and 2 per cent. of sodium silicate. This is applied to the tube, which has been loosely wound with a spiral of iron wire, and forms an adherent, easily repairable covering. *US*(*c*) has a heat-resisting tube with a light asbestos and cement covering. Its total weight is 25 lbs.

Insertion by Trolley or Hand (*Table* I).—The first four instruments form self-contained units complete with trolley. The pipe can be rotated so that, with the end piece horizontal, it can be

TABLE I.—*Modified Designs of the Quick-Immersion Thermocouple for Use in Large Furnaces.*

Works.	Furnace.	End block.	Indicator.	Thermocouple. Wire dia. Mm.	Thermocouple. Cold junctions.	Main tube. Material.	Main tube. Dimensions.	Main tube. Insulation.
1.	2.	3.	4.	5.	6.	7.	8.	9.
Operated by trolley.								
H	O.H.	Fosalsil.	M.	0.5	I.	Steel.	17 ft. × 1⅝ in. × ¼ in.	Economite.
FB	O.H.	,,	P.	0.5	O.	,,	15 ft. × 1⅝ in. × $\frac{5}{32}$ in.	,,
ESC	Arc.	,,	P.	0.5	O.	20/25 nickel-chromium steel.	14 ft. × 1 in. × ⅛ in. ..	None.
US(*s*)	O.H.	,,	M.	0.5	I.	Steel.	15 ft. × 1⅛ in. × $\frac{5}{16}$ in.	Economite.
Operated by hand.								
J	O.H.	Fosalsil.	P.	0.5 / 0.3	O.	Steel.	12 ft. × 1¼ in. × ⅛ in. ..	Cement.
US(*c*)	Arc.	Non-pareil. Carbon.	M.	0.5	O.	20/25 nickel-chromium steel.	11 ft. × 1 in. × ⅛ in. ..	,,

Contractions used and notes:
Col. 1: *H* = Hadfields, Ltd.; *FB* = Thos. Firth and John Brown, Ltd.; *ESC* = English Steel Corporation, Ltd.; *J* = Wm. Jessop & Sons, Ltd.; *US* = The United Steel Companies, Ltd.; (*c*) = S. Fox & Co., Ltd., in conjunction with Central Research Department; (*s*) = Steel, Peech and Tozer.
Col. 2: O.H. = open-hearth.
Col. 4: P. = potentiometer. M. = millivoltmeter.
Col. 5: Jessop's employ 0.5-mm. wire in the open-hearth pyrometer and 0.3-mm. wire in all other apparatus.
Col. 6 refers to position of junction between thermocouple wires and compensating leads: O. = outside furnace. I. = in head of pyrometer, *i.e.*, inside furnace.
Col. 8: Figures are the length between perpendiculars, outer diameter, and wall thickness, respectively.

Again, other things being equal, the temperature actually attained by the wires obviously depends on the dimensions of the main tube and its insulation, and on whether the apparatus is used for single readings at wide intervals or a rapid succession of readings. For example, the instrument *FB* has its main tube covered with 1½ in. of the highly insulating material Economite, so that the temperature rise of the tube for each insertion is not great, but the effect tends to be cumulative, and it was found that, after 4 or 5 immersions made within an hour, the tube had risen to a temperature of the order of 300 deg. C. In this case, the couple of 0.5-mm. wires extended through the hot region, and it was observed that the error in the reading of a millivoltmeter of 300 ohms resistance after 1 hr. amounted to some 20 deg. C. On the other hand, a bare tube, as in the *ESC* instrument, though it may be red-hot on removal from the furnace, may cool so rapidly as to give little cumulative effect in readings 15 min. apart.

If the millivoltmeter is to continue to be used, further experiment seems necessary to arrive at the best design of apparatus and to define more exactly its safe conditions of use.

D

Liquid Steel Temperatures

inserted through a low, or partially opened, doorway. With its radiation shield and great length, this type obviously affords a high degree of protection to the operator.

The other two instruments are intended to be transported by hand, requiring an independent support for insertion into the furnace. Thus, they may be slid over rollers attached to a separate stand, or over a bar in the furnace mouth. For any sliding motion, a completely bare tube has obvious advantages.

The decision as to whether to adopt the trolley or the hand type of apparatus depends on a number of factors, such as the size and type of furnace, the storage space available, and the size and condition of the floor in front of the furnace.

For the smaller furnaces, the designs at the several works are considerably simpler.

Apparatus for Ladle, Trough and Launder

The apparatus for use in the ladle or the trough calls for no detailed comment. Since slag is present in the ladle, an end block must be used, and the instrument may be in the original form described, with or without modifications.

In the launder, the original proposal was to use a thick-walled silica tube to be inserted in the stream when inclined at an angle. Such a tube tends to bend, owing to the force of the stream, before a reading can be obtained, and it is thought that this may give rise to error. The National Physical Laboratory is now investigating the possibility of improving the design.

General Questions Relating to the Quick-Immersion Thermocouple

(*a*) *Best Diameter of Wire for Platinum Thermocouple.*—Two diameters of wire, 0.5 and 0.3 mm., were employed in the original work, and it was pointed out that, if the latter could be used, the cost of replacement would be little more than one-third of that for the larger diameter. On the other hand, the mechanical strength of the smaller-diameter wire would be very much less. The ideal diameter would obviously be one with which failure due to mechanical breakdown in handling, etc., would be as likely to occur on the average as that due to contamination.

A decision in this matter is affected to a considerable extent by the length of the couple. In the original work a short length of couple and long compensating leads were used. If, as in most of the designs summarised in Table I, the platinum wires are carried to the colder end of the apparatus, including passage round the bend, it is obvious that much greater strain would be placed on the wires. The matter seems to be one on which further comparative tests are desirable.

(*b*) *Frequency of Renewal of Platinum Thermocouple.*—The evidence adduced in the last Report suggested that almost certainly 10 immersions of the 0.5-mm. couple, of average duration of 15 secs., and possibly 20 or more immersions would be allowed in an open-hearth without appreciable deterioration occurring.

Thos. Firth & John Brown, Limited, have now supplied the additional data bearing on this point recorded in Table II.

Table II.—*Deterioration of Thermocouples with Use.*

Furnace.	Total time of immersion.	Error against unused couple.
	Sec.	Deg. C.
High-frequency	168	4 low
Siemens	297	5 low
,, ...	218	1 high
,, ...	431	15 low

At present it must be remembered that, while it is difficult to determine the rate of deterioration of a thermocouple with immersion time, a maximum discrepancy of 5 deg. C. may be expected after 200-250 secs., or about 15 immersions of normal duration.

Wm. Jessop & Sons, Limited, have carried out tests on the constancy of their 0.3-mm. thermocouples by comparison with a standard couple in a platinum-wound furnace at 1,400 deg. C. Their procedure with regard to renewal of the wire is to scrap the hot end of the couple when it shows signs of becoming brittle. Under these conditions it is found that the couple never reads high, nor does it read low by more than 10 deg. C. Consequently the potentiometer is set to read 5 deg. C. high, so that values can be relied on to an accuracy of ± 5 deg. C. The following figures, taken at random from the record of couples used for from 20 to 30 immersions a day in high-frequency furnaces show the errors likely to be encountered. In each case the two readings indicate the values for immersions of 6 in. and 2 in., respectively:

	Immersion.	
	6 in.	2 in.
(1)	1 deg. C. low.	7 deg. C. low.
(2)	3 ,, ,,	7 ,, ,,
(3)	0 ,, ,,	9 ,, ,,
(4)	1 ,, ,,	6 ,, ,,
(5)	3 ,, ,,	—
(6)	1 ,, ,,	2 ,, ,,

(*c*) *Life of Fosalsil End Blocks.*—Two alternatives to the Fosalsil end blocks have been referred to above, but the blocks continue to be in frequent use. At Thos. Firth & John Brown, Limited, the life of a block in the acid open-hearth furnace has been found to be 15 immersions. This figure may be exceeded in the high-frequency furnace (acid), in which the slag can be moved to one side when immersing. Immersions made in cool metal, however, tend to reduce this number, owing to damage or wear caused by the removal of the additional slag or metal adhering to the block.

This section of the Report concludes with some examples of the application of the quick-immersion thermocouple to a number of special problems, and the possibility of routine control is discussed.

New German Acid-Resisting Steel

According to W. A. Hamor in "Chemical and Engineering News," a new steel containing 11 to 18 per cent. Sb, 0.1 to 0.3 per cent. Be, up to 5 per cent. Mo and 5 per cent. W, which resists hydrochloric acid, has been developed in Germany. Cr-Ni austenitic steel containing tantalum and niobium carbides has been found superior to Cu, Fe or Al for vessels for cracking fats and oils, for the oxidation of paraffins and for distillation purposes in the chemical industry.

(*Continued from next column.*)

cially as the material is inexpensive, so little is actually consumed per casting and because no special apparatus or skilled labour are required to give the desired results.

Bakelite sealing solutions are suitable for both ferrous and non-ferrous metals. It is not proposed that the process can reclaim castings with gross defects; such material must be plugged or definitely scrapped; the Bakelite process is intended only to remedy castings of slightly substandard quality.

Such a method of reclamation will have a welcome when every casting put into service is a direct gain for the war effort. The process is already being employed with success with a saving of time, money and labour, and it is obvious that the method should be acceptable not only by founders, but also by engineers to whom slightly faulty castings have been delivered.

It sometimes happens that failure of these castings is not discovered until a considerable amount of valuable work has been carried out, and it would be very discouraging if the castings were then to be returned to the melting-pot. It is especially to be noted that if, after machining, a casting were found to possess porous patches, the Bakelite process could then be carried out with likelihood of success.

In carrying out this method of reclamation, it is important that the castings should be dry; if a hydraulic test has been carried out before processing, the castings should be heated in an oven for about 3 hrs. at 130 deg. C. It is obvious, however, that the Bakelite solution itself (being of low viscosity) can be used as the pressure-test medium; it is convenient that the solution is dark brown in colour, so that any "sweating" through the walls can be easily seen.

Castings which, on test, have been definitely regarded as hopeless, and consequently set aside as "scrap" on account of porosity, have been reclaimed and rendered fit for service.

Salvaging Porous Castings

Whilst there are many methods available for the reclamation of porous castings, ranging from curious recipes handed down from the Dark Ages to welding, yet interest must be aroused when an entirely novel process comes on the market. In the latest process, developed by Bakelite, Limited, of London and Manchester, there is an *ab initio* recognition of two types of porosity, slight and deep seated. For the former a clear solution, V 1845, is available, and for the latter N 2106, which contains a finely divided filler.

These materials are solutions of a special Bakelite synthetic resin. From what follows it will be realised that the method is simple and inexpensive. There are two methods available, the choice of which depends upon the size and nature of the castings—one for small castings which are treated in batches, the other for large hollow cylinder castings. The first method, applied to small castings, would be carried out in a vacuum-pressure vessel and in a manner resembling the well-known vacuum impregnation process. This method is not described in detail here, but further information is available if required.

For treating the larger castings, no elaborate apparatus is required, the essential being a pump to deliver the fluid and to exert a pressure of the order of 250 lbs. will suffice.

It is first necessary to fill the casting with the Bakelite solution after stopping up all ports except one at the base for entry and one at the topmost part of the casting for exit of air and as an overflow, indicating that the casting is full. When the solution appears at the top exit, this is closed, and pumping is continued until about 250-lb. pressure shows on the gauge.

The external walls of the casting are now examined carefully to ascertain whether any of the Bakelite solution (brown) has percolated through. If after about ten minutes (during which time the pressure is maintained) no leaks are observed, the casting may be considered as sound with respect to porosity. Whether any leaks occur or not, the casting should now be submitted to a "curing process." This consists in heating the casting for about 3 hrs. at a temperature of 100 to 135 deg. C., after which time the casting should become effectively sealed.

It is to be noted that, whereas the Bakelite in the sealing solution was soluble, the heat in the curing process has converted the Bakelite into an inert solid within the pores of the metal. In this cured condition the Bakelite is quite insoluble, and infusible at any working temperature.

As Bakelite resin in the cured stage is one of the most chemically-inert substances known, Bakelite is applied in various forms for the purpose of protecting metals from corrosion, or other chemical attack. Thus, any film of the sealing solution left upon the walls of the castings would, incidentally, be advantageous.

Stability of Cured Bakelite

Careful experiments have been carried out to test the stability of cured Bakelite under exacting conditions, and among these tests may be mentioned the following:—

It has been found to be quite unaffected by boiling water, hot oil (at 125 deg. C.), diethylene glycol and other organic solvents. It is, of course, unaffected by acids (except those of a strongly oxidising character, such as strong sulphuric or nitric acid). The process, briefly described above, has already been approved by the U.S.A. naval authorities, and it is now being accepted in this country by firms doing important Government (naval and aircraft) work.

The Bakelite process has met with approval in several firms connected with light-alloy castings, and there appears to be good reason for the method to be adopted for general use, espe-

(*Continued at foot of preceding column.*)

The Manufacture, Specification, and Use of Phosphoric High-Duty Irons

(*Continued from page* 194.)

Structure Control

Dealing with the point of structure, it would be seen from the specification exhibited that the composition, both of the metal itself and of the graphite, was only important in so far as it assisted in obtaining the particular structure desired. By various devices the structure, both of the graphite size and the metal matrix itself, could be brought within a considerable measure of control. One thing to bear in mind was that the more the graphite was refined the more the capacity for yield was eliminated. This was indicated in the deflection which showed itself as a small elongation on a tensile test. Coarse graphite iron would bend relatively more than a fine graphite iron of the same composition and of the same section. Taking a bar of high-duty iron and a bar of common iron with a coarser graphite, the common iron, for the same load, would show more strain, because the larger graphite flakes gave it a greater capacity for yield, but the coarse graphite iron for that very reason would break sooner, while the high-duty iron would continue to withstand the load until it broke at a much larger deflection and a much bigger load than the coarse graphite iron. Hence, when the graphite was refined, the ductility had to be transferred to the metal.

Acicular Irons

With the recently developed acicular irons, concerning which Mr. MacRae Smith read a Paper recently, one point which impressed him (the speaker) concerning them was their capacity for being cast into sections with steadily increasing strengths and deflections as the section became thinner. In many of the high-duty irons, the strength of which went very high, the carbon was low, and the graphite was small, and thin sections would tend to go white. This did not seem to apply to these irons, and strengths were being obtained of 45 tons per sq. in. on the small 0.6 in. bar. Referring to the standard 1.2 bar for comparison, deflections of B.S.I. specifications would be about 0.1 to 0.2. The corresponding deflection of acicular material became of the order of 0.2 and even 0.4 of an inch, almost approaching the order obtained from austenitic iron. These were deflections of an order which showed as measureable elongation in tension, approaching the ideal which Mr. Phillips apparently had in mind. Nevertheless, he, the speaker, would be leading his hearers astray if he caused them to think that a ductile cast iron could be produced at a moment's notice. Having regard to the structure of cast iron used at the present time in the engineering industry, this could not be obtained even if there was no graphite in it. The carbon in the pearlite would prevent it.

Limitation of Chemical Composition

Mr. A. L. Key assumed that chemical composition was not a controlling factor. This confirmed what he had been saying for many years now. Naturally when viewing the casting, and the material put into it, work was being done on a standard of composition for that particular type of section, but the ultimate result depended upon the material used to obtain that analysis. In other words, similar analyses might be obtained from two actually differing materials. Personally, he held the opinion that cast iron was ductile, but that it was not ductile upon elongation.

Mr. Pearce had spoken of deflection on the smaller bar and the larger bar. This was correct. Articles could be bent, but from that point of view it could not be necessarily stated that the metal was ductile. Deflection could not be put into the same category of being ductile; it should be called spring, because once the load was released the metal returned to its original position.

As a matter of general interest he could state he had made material which had bent; in fact, he had had to bend it in the case of some large hydraulic pumps which were made. He had occasion to break one up. It was a fairly tough mixture, being made from 30 per cent. steel and 20 per cent. white iron, and carried an average section of 3 in. Every time the section was hit before it was broken the casting was bent with a pronounced bend, and there was a mark on the top where the hammer impinged on the casting. Instead of breaking off with a sharp break, as might be expected in the case of cast iron, it was torn, showing a fibrous character. Therefore, he contended that the engineer could be given an assurance that cast iron was ductile.

Thermal Shock

Mr. C. R. van der Ben also referred to ductility and phosphorus content, and the necessity for complying with specifications stipulating various ratios of phosphorus content. Specifications dealt almost exclusively with tensile strengths. He would appreciate further information with regard to increasing phosphorus content and shocks resistance, particularly from the aspect of thermal shock. Would the higher phosphorus irons resist that shock in comparison with so-called lower phosphorus material?

Mr. Pearce replied that, so far as mechanical shock was concerned, phosphorus was definitely bad; each 0.1 per cent. of phosphorus reduced the impact strength about 5 per cent.; 1 per cent. phosphorus iron had only half the impact strength of hematite. With thermal shock, the conditions were similar. If a casting was required to resist thermal shock, the phosphorus content must be kept low. The term "thermal shock" should be emphasised, because it was not necessarily the same thing as mere heating and cooling, but there must be sudden heating and sudden cooling in order to get a shock effect. There must be a sudden demand for the material to expand or contract in order to create a shock effect. There was no doubt that the presence of phosphorus had a bad effect, and this was mainly the reason why ingot moulds were made of a low phosphorus material. As far as ingot moulds, and castings of that type, were concerned, including slag ladles, anything which had to withstand the impact of molten metal, many of them had been made with hematite, so that the discarded moulds could be charged straight into the acid steel furnace. Basic Bessemer steel was not made very much in this country before the war; we had to be content with merely inventing it.

As a result of the necessity for using ingot moulds as scrap for steelmaking, they had to be made of hematite, but in point of fact increased life was obtained by slightly raising the phosphorus content up to, say, 0.2 per cent. There was evidence that a longer life could be obtained from a steel ingot mould; that is to say, an ingot mould for making a steel ingot, if the phosphorus content was slightly higher than the hematite value.

Phosphorus and Soundness

In view of what had been said concerning thermal shock, a query might be raised. It was due, in part, to the fact that a slightly sounder casting could be obtained—at any rate, in a heavy section—from an iron containing a low phosphorus content than from one which carried a minimum quantity of that element. It was known that if phosphorus were put into an iron it did not generally have quite so much carbon. Phosphoric pig-iron was always lower in carbon than was hematite. Many high phosphoric pig-irons had less than 3 per cent. carbon to commence with, owing to the presence of the phosphorus. If phosphorus was used, the metal carried lower carbon, and was less detrimental than the carbon which was removed. In general, for applications involving thermal shock, the phosphorus content should be kept low.

Mr. E. Longden thought that another typical phase of the introduction of phosphorus to hematite iron, or the increase of phosphorus in hematite iron would be the prolongation of the cooling period. The graphite size would be increased. The best material to withstand thermal shock would be metal of hematite nature with the graphite well developed.

Mr. Pearce said that with the phosphorus content he suggested there would be a more continuous structure which was less liable to contain shrinkage cavities, and there would be a better thermal conductivity. The temperature did not rise so much, and therefore the life was longer and the degree of shock was diminished.

A Venting Problem

Mr. A. Sutcliffe (Bolton) first raised a point with regard to Mr. Tyrie's remarks. Referring to the oil-sand core in a particular illustration, Mr. Tyrie stated there was no vent taken off. He (the speaker) remembered, many years ago, a moulder attempting to use oil sand cores in a circular casting without taking off vents, and the result had been parallel to that cited by Mr. Tyrie from which he agreed that lack of venting was indeed the source of the wasters experienced.

With reference to refined iron and high-duty iron he thought there was a certain amount of exaggeration in regard to the commendation of them, and as to what could be done with them.

He had made lathes 26 years ago which were still working six days a week, and he had also seen planers and lathes which were 100 years old and still working. These statements could be regarded as an excellent testimony to the quality of the iron used in former days.

Dealing with Mr. Pearce's remarks, could that gentleman state the physical mixture, not the chemical composition, of the two irons mentioned? McLain had taught foundrymen how to add steel to a charge in 1908. Would Mr. Pearce call such a product a refined iron or a high-duty iron?

As regards putting steel into iron, in 1864 there was a large hammer block cast in Bolton into which many tons of steel were put; so that it was obvious foundrymen were acquainted with steel mixtures even in those days. When making a ram 6 ft. long, 14 in. diameter, how did Mr. Pearce put a head on it when using high-duty iron; and if he did put a head on it would he put a feeding rod into the head?

Mr. Sutcliffe further stated he had brought with him a sample of a twin cylinder. There had been a perfect mould, but not a perfect iron. If there had been a perfect mould and a perfect iron, either refined iron or high-duty iron, would the cylinder have been a good one? The cylinder had been working ten years and doing good service. The works were then closed, with the result that the cylinder was broken up for scrap. The sample of the middle wall showed poor metal. Then the firm concerned installed a laboratory and engaged chemists. The time seemed to be coming when chemists would be responsible for the quality of the iron used, and the moulder for providing a perfect mould. Would high-duty or refined iron have done away with the defect of the particular casting exhibited?

Many firms in the Lancashire area were

Phosphoric High-Duty Irons

making castings for two makers, and the biggest firm of all never used pig-iron but just machine scrap. He would like to hear Mr. Pearce's views upon that point. With respect to cupola charges of 20 per cent. refined iron and 80 per cent. scrap, the scrap being composed of rusty iron and badly burnt iron, was it possible to make a good casting and machine it afterwards?

It had been stated in connection with one of the illustrations that six castings had been made in a box. Was not this too many? Some of the castings had been run in first, with the result that a scum had formed on the top.

Mr. Tyrie said there was no vent taken off the oil-sand core. The casting was not a very large one, and would probably not weigh more than 28 lbs. It was thought, in the shop, that there was no necessity to take a vent for such oil-sand cores. Subsequent experience demonstrated that, small as the casting was, it did require to have a vent taken off it. Mr. Sutcliffe's experience bore this out, but of course on a much larger scale.

Preparation of Charges

Mr. Pearce thought that the answer to several of the questions raised by Mr. Sutcliffe could be couched in the language of Mr. Asquith on a celebrated occasion, when he replied: "The answer is in the interrogative." Expressed in other words, he (the speaker) could not possibly pronounce by way of question and answer with regard to the defects shown in the cylinders to which reference had been made, or deal with the ram problem, without having much more detail and evidence to go upon than that which had been furnished upon that occasion.

The difficulty of melting in the one furnace at one time phosphoric pig and steel scrap was well known. As far as the melting of all scrap mixtures was concerned, similar conditions appeared to apply as in the case of ordinary pig-iron mixtures. If it was known what was being put in, then the mixture could be controlled, and what was required could be obtained. The problem about scrap was that it was not known of what it consisted, and that it was so varied in character. The best plan was to pig beforehand, and ascertain what resulted.

Thermal Conductivity

Mr. A. L. Key, referring to thermal conductivity and drawing a comparison with ingot moulds, said the point was again brought down to the phosphorus content. Usually a material as low in phosphorus content as possible would be selected when a very great degree of heat was applied, say, the heat to which an ingot mould was subjected. It had been discovered that the thermal conductivity was not controlled by phosphorus. It would probably be agreed that, using the same materials and the same quantities, to obtain a mixture in various stages, up and down, there would be a total carbon content plus silicon content. What appeared to control the thermal conductivity of such materials was the position of the silicon in relation to the total carbon. To substantiate this statement he would explain that he had had occasion to make some pots which had to withstand a very high ratio of heat. They were for melting purposes, and he had a failure with one of them. It was customary to analyse the pots, and the customer required a copy of the laboratory analysis. The failure of the pot was due to the carbon content being considerably lower than in any other pot, and the silicon content was much higher. The reason was because a fresh consignment of pig-iron showed hematite which did not conform to the specified analysis, with a specially high manganese content. The basis of the life of an ingot mould appeared to depend upon the relation of the carbon to the silicon.

It was advisable to imagine, when making ordinary steel-mix or steel mixed with hematite, what was occurring in relation to the silicon and the carbon, or the size of the free graphite. The state of the graphitic carbon was the dominating factor, coupled with a low phosphorus content, but the low phosphorus content itself was not the dominating factor. It was the ratio of the carbon in relation to the silicon which controlled the low conductivity.

Mr. W. Dunkerley (Oldham) also referred to thermal shock. At one time considerable trouble was experienced with regard to cylinder heads breaking. The trouble ceased when the phosphorus content was reduced to 0.3 per cent. Were cylinder heads and cylinder liners subjected to the kind of thermal shock mentioned and to deal with which a low phosphorus content was necessary? He was referring to an internal combustion engine.

Mr. Pearce replied in the negative. Probably the conditions of heating and cooling would be sufficiently gradual to rule out shock, and the reason for the defect would have to be sought in other directions.

Strength of Last Charges

Mr. R. S. Turner (Manchester) pointed out that the statement had been made that it was possible to make a Grade 3 iron with a high phosphorus content of, say, 1.2 per cent. There had been difficulty experienced in obtaining tests in the last two charges of the heat. Was it possible to obtain the same test at the end of the heat as in the middle of it?

Mr. Pearce: Grade 3 with 1 per cent. phosphorus?

Mr. Turner: With an alloy addition, of course.

Mr. Pearce thought it was a high phosphorus figure for a Grade 3 iron in any case. It would be in a very narrow range of silicon and carbon. It was not advisable to go above 0.6 for a Grade 3 iron, and preferably 0.3. Was Mr. Turner certain that the phosphorus did not go off in the last two heats?

Mr. Turner said he wanted to learn whether it was possible to get the result with a high phosphorus iron or must reliance be placed upon a low phosphorus iron?

Mr. Pearce replied that he would certainly not go above the figure mentioned for Grade 3 iron. He could not say, offhand, why it should go off in the last two heats.

Mr. Turner said he was really referring to something else. Difficulty was experienced in getting the high tension. He was not referring to Grade 3; but was it possible to get the same test at the end of a blow as that which was made in the middle of the blow?

Mr. Pearce thought it was.

Mr. Tyrie thought, as the result of his own experience, equally good tests might not be obtained at the end of the day's blow as were possible during the earlier part of the blow, unless the cupola conditions were very satisfactory throughout. There was a tendency for the cupola to melt rather slower at the end of the day. Perhaps the tuyeres were becoming blocked up, and the cupola itself had become a little dirty. The result would be a slowing down. The metal would therefore be picking up more carbon in such conditions, and the tests would not be as high at the end of the day as in its earlier period. That might perhaps explain the difficulty.

Mr. Pearce: Were you blowing down?

Mr. Turner: Yes.

Mr. Pearce: That might explain it.

Six Old Bills make One Washer for a Shell. Four Food Cartons make a Box for Aero-Cannon Shells. One Soap Powder Canister makes Four Aero-Engine Gaskets.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

541,422 Hall, I. Crucible furnaces.

541,473 Anaconda Copper Mining Company. Stripping electro-deposited metal sheets.

541,520 Salvaneschi, P. Moulding of hollow bodies, such as pipes, from a pasty material.

541,544 Haddan, R. (Corning Glass Works). Refractory castings for glass-making and other apparatus.

541,864 Fleischmann, A. Method and apparatus for refining molten metals.

542,063 Jacobsen, O. B. Centrifugal apparatus for separating dust and grit from air, flue or blast-furnace gases.

542,145 Automatic Telephone & Electric Company, Limited, and Roseby, P. N. Methods of producing nickel-iron powder.

542,410 Alloys, Limited. Method of production of powdered alloys or carbides.

542,426 Corning Glass Works. Manufacture of castings high in zirconia.

542,448 West, T. T. Heaters for air for furnaces and the like.

542,472 McDonald, J., and G.W.B. Electric Furnaces, Limited. Conveyance of articles through furnaces.

542,494 Ormiston, H. O. Fluxes for use in the production, re-melting, and casting of aluminium and its alloys.

542,543 Cartner, J., and Renold, P. Apparatus for applying internal coating to cans or like containers.

542,550 Haddan, R. (Corning Glass Works). Manufacture of heat cast refractories.

542,573 Horgard, G. Production of ferro-alloys with low content of carbon.

542,576 Magnesium Elektron, Limited, and Fox, F. A. Rolling of magnesium and its alloys.

542,598 Electric Furnace Company, Limited, and Spanswick, J. R. Furnaces for the melting or other heat-treatment of metals and the like.

542,614 Soc. Anon. des Hauts-Fourneaux et Fonderies de Pont-a-Mousson. Methods and plants for hooping pipes and like pieces.

542,632 Jorgensen, M. Vogel-. Refining of scrap iron.

542,647 Crown Fastener Corporation. Method and apparatus for forming and trimming die castings.

542,803 Hill, E. Means for flanging the ends of malleable pipes or tubes for jointing purposes.

542,834 Standard Oil Development Company. Method of decreasing metal corrosion.

Testing of Welds

At a meeting of the North-East Coast Institution of Engineers and Shipbuilders, held at Newcastle-upon-Tyne, on March 6, Mr. H. N. Pemberton presented a Paper on "The Testing of Welds."

The Paper was presented as a critical and informative survey of the tests applied in industry for the purpose of assessing the strength properties of welded joints. Fatigue, tensile, bend, impact and special crucial tests were discussed in detail, and the significance of these tests, together with factors which might be peculiar to welding and which influenced the results obtainable, were dealt with. Representative test results obtained from authoritative sources were given, and with regard to fatigue the author summarised in tabular form the main results obtained by British, American and Continental investigators, figures which might prove helpful to designers, especially in view of the increasing use of welding in the engineering and shipbuilding industries at the present time.

That increase had been accelerated by the wartime requirements of industry generally. The need for speedy production, and the replacement of iron castings by fabricated mild steel in order to obtain improved resistance to explosive shocks, were two of the main considerations involved. It was therefore important, stated the author, that testing methods should be thoroughly understood in their relation to welding, and it was with that in mind that the author endeavoured to deal with the subject in the light of his own experience. Brief reference was made to X-ray and magnetic methods of inspection.

Fuel Economy in the Iron and Steel Industry

At a recent meeting of the Fuel Luncheon Club in London, Mr. E. C. Evans, B.Sc. (Director of Research, the British Iron and Steel Federation), gave an address on "Fuel Economy in the Iron and Steel Industry," more particularly with reference to developments in the past 20 years. The speaker recalled the setting up of the Fuel Economy Committee of the Federation in 1923, and the steps taken to examine possibilities of reducing fuel consumption generally throughout the steel industry.

Blast-Furnace Practice

The Fuel Economy Committee decided to commence with an investigation of the blast furnace, the most important individual fuel user in the country. As a first step in the examination of the problem affecting blast furnaces, accurate figures had to be obtained to determine the performance of individual furnaces, and the questionnaire method was resorted to—not a popular method, because if complete information was to be obtained the questionnaire had to be rather elaborate. This difficulty was overcome by appointing local committees in each of the various producing districts. An active committee of blast-furnace managers was appointed on the North-East Coast, which drew up a questionnaire which, when completed, gave records of the operation of 12 blast furnaces which were as accurate and complete as anything yet published. With this as a basis similar returns were obtained from other producing districts. These local committees were subsequently merged into a National Blast Furnace Committee.

It was soon found that the factors differed so much between different blast furnaces that it was very difficult to devise a method by which an accurate assessment of their performance could be made. Industry, however, was beginning to make use of characteristic curves in determining furnace performance. These are based on the fact that in every industrial furnace heat requirements include:—(1) A constant heat input to maintain temperature in the hearth; (2) a heat input directly proportional to the material heated.

It is therefore possible to develop a characteristic furnace curve correlating fuel consumption with output. These two quantities could be analysed to include most, if not all, of the variables concerned in blast-furnace operation, and ultimately a general curve, characteristic of all blast furnaces, was evolved by means of which the performance of individual furnaces could be assessed.

Once the blast furnace had been dealt with, it was possible to proceed with the examination of ancillary plant, stoves, blowing plant, etc., all big users of blast and energy. Blast-furnace stoves, for example, which are big heat-consuming units, were in the past often very inefficient—60 to 65 per cent. was not uncommon—as compared with efficiencies of well over 90 per cent. in some of the modern plants. Any fuel saving in the blast-furnace stove meant that more fuel was available for the other units of the plant.

Similar economies have been obtained in the utilisation of blast-furnace gas for boilers and furnaces. Once the heat supplies going to an individual unit could be measured and correlated with the output from that plant, whether in the form of hot blast, steam, or hot metal, then possibilities of effecting improvements could be examined, and these were the subject of consideration by a series of sub-committees all reporting to the Blast Furnace Committee.

Separate committees were formed to deal with iron ores, air blast and its production, blast-furnace slags and refractories, operating practice, and so on; and, lastly, to examine the fundamental scientific aspects involved in blast-furnace operation, a Scientific Panel has been formed under the chairmanship of Dr. Sinnatt, including scientific authorities in the country, from the national research organisations, universities and others, to study the fundamental factors involved in blast-furnace operation.

The results of the work outlined are shown by the fact that, between 1924 and 1937, blast-furnace fuel consumption in this country dropped from over 40 cwts. per ton of pig-iron (a figure which had been practically stationary for over 40 years) to less than 35 cwts. per ton, a saving of 5.2 cwts. per ton of pig-iron, and this tendency was still proceeding when the war broke out.

Open-Hearth and Rolling-Mill Practice

With an experience of the procedure developed for the examination of blast furnaces and with the machinery built up for a study of the problem, attention was directed to open-hearth practice. In this work, committees were formed to deal with methods of measurement, gas-producers, open-hearth slags, open-hearth refractories, and other factors. Reports of all of these committees are circulated to the industry as a whole, but, in addition, conferences of open-hearth managers are called from time to time. At these conferences reports are presented of the work of various sub-committees dealing with open-hearth practice. Discussions take place dealing with specific problems in the industry, and a free and frank exchange of information and experience is effected which has had a most important bearing in improving general practice in the trade.

The results of this co-operative work are more striking even than those obtained in blast-furnace practice. In 1924 10.3 million tons of coal was used in the production of steel, represented by 8.2 million tons of ingots. In 1937, 8.9 million tons of equivalent coal only was used in the production of 12.98 million tons of ingots, a reduction from 25.2 cwts. per ton of steel to 13.7 cwts., and even under war conditions there is still a steady reduction in fuel, taking the country as a whole. These are Mines Department figures, but are not strictly accurate as the quantity of coke-oven and blast-furnace gas used supplementary to coal is not given. Even after allowance is made for this the reduction in fuel consumed is very substantial.

There was in steel-making practice greater room for economy than in the case of the blast furnace, partly owing to the inherent inefficiency of the steel furnace and to the possibilities of improving practice by modification of design. This is a subject to which considerable attention is now being directed both from the fundamental and the practical standpoints. One example of the type of work going on is that concerned with the examination of the aerodynamics of open-hearth furnaces in use in this country, including a study of their design and the measurement of the gas flow to the various constituent parts of the furnace. In several cases it has been found possible to modify the design to obtain better aerodynamic conditions, and to get a considerable improvement in output and efficiency. One interesting point has arisen from the speeding up of these furnaces. Far greater attention has had to be paid to refractories, and a considerable increase in life has already been attained. There is room, however, for further developments in this direction. If refractories could be improved which would allow of furnaces being worked at higher temperatures, possibilities of improved fuel economies would be greatly extended.

Rolling-mill fuel practice has been examined by the same methods as were developed with blast-furnace and open-hearth practice. Useful results have been obtained by time studies, and increased rolling-mill outputs have resulted with consequent important improvements in fuel economy. Steam consumption of mills has been measured with consequent improved efficiency, an interesting problem being solved in measuring pulsating steam flow. Methods of measurement are now being devised to determine rolling pressures and roll torque, whilst an investigation is in progress into rolling-mill bearings, a subject of importance, as can be realised by the fact that in one mill a change in the type of bearings saved 60 per cent. of the power input to the mill.

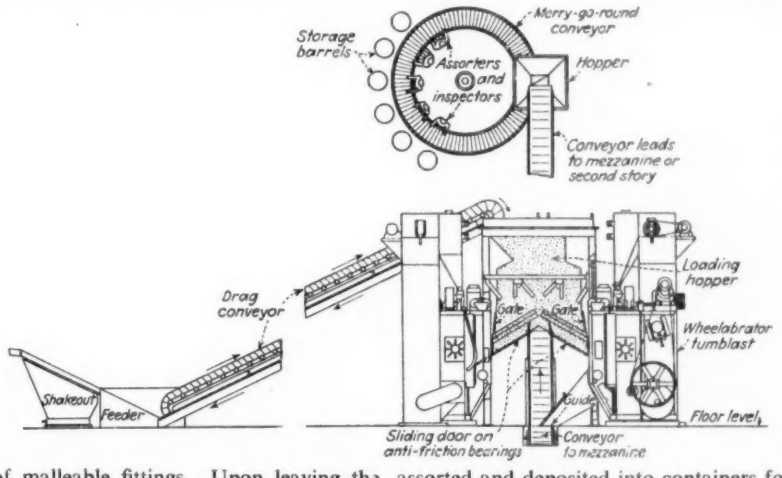
General Survey

Surveying the work as a whole, it may be said that immediate results have been obtained by the application of existing knowledge to operating practice. This has been followed up by a study of fundamental problems requiring long-term investigations. At the outset also, economies were easy to effect, but as the work developed the law of diminishing returns applied, so that in the well-managed works of the industry to-day the savings that can be effected are often a small fraction of what was possible when the work started. There is room for improvement in small works which are not able to maintain fuel officers, and in that connection the Institute of Fuel can play a most important part.

Finally, it is important to maintain as far as possible the quality of the coal to the industrial plants. Cases have been brought to notice where the use of an inferior type of coal has led to an increase of 10 to 15 per cent. in consumption. Such an increase, with its consequent cumulative increase of fuel consumption for extra transport, handling, and so on, would seriously counterbalance any saving in fuel obtained by more rational methods of utilisation, so that every effort should be made in the distribution of fuel to ensure that fuel to the vital industries should be as uniform and of as suitable a quality as possible.

An American Mechanised Cleaning Plant

The ingenious conveyor arrangement shown in Fig. 1 is utilised by Walworth Company, Greensburg, Pa., to reduce time required to clean its output of malleable fittings. Upon leaving the annealing ovens, castings are dumped into a vibrating shakeout screen, which in turn passes them on to the feeder of a continuous conveyor. This conveyor elevates the castings to a loading hopper located between two 48 × 42 in. Wheelabrator Tumblasts.



Castings are fed by gravity, under manual control, to either of the two Tumblasts as desired. After cleaning, they are dumped through a chute on to another conveyor which carries them up to the mezzanine. Here they pass into a hopper which feeds on to a revolving table where they are inspected and assorted and deposited into containers for trucking to shipping room or galvanising department.

Usual load for each machine is about 1,700 lbs. of assorted sizes. Cleaning time ranges from 4 to 5 mins. for large pieces and a maximum of 15 mins. for small castings. No. 25 steel shot is used for abrasive.—"Iron Age."

Powder Metallurgy Nomenclature

AMERICAN SOCIETY OF METALS DEFINITIONS

To clarify nomenclature in powder metallurgy, one of the newest branches of the science, a sub-committee of the Metals Handbook Committee of the American Society for Metals was formed to define, as far as possible, many of the words in current use. These definitions have now been published in "Metal Progress," from which the following list has been abstracted.

The terms are in alphabetical order except for the definition of Powder Metallurgy, which is as follows: "Powder metallurgy is the art of producing metal powders and shaped objects from individual, mixed, or alloyed metal powders, with or without the inclusion of non-metallic constituents, by pressing or forming objects which are simultaneously or subsequently heated to produce a coalesced, sintered, alloyed, brazed, or welded mass, characterised by the absence of fusion, or the fusion of a minor component only."

Air Separation.—The classification of metal powders into particle size ranges by means of a controlled air stream.

Apparent Density.—The weight of a unit volume of powder, usually expressed as grammes per cc. or grammes per cub. in., determined by a specific method of loading.

Atomisation.—The dispersion of a molten metal by gas or liquid pressure into small particles which solidify upon cooling.

Binder.—A cementing medium.

Blank.—A pressed, pre-sintered, shaped, cut or sintered compact of powdered metal, usually in the unfinished condition.

Bridging.—The formation of arched cavities in a powder mass which results in voids in the sintered compact.

Briquette.—(Synonymous with *Compact.*)

Cake.—A mass of weakly coalesced metal powder resulting from the reduction of metal oxides.

Carbonyl Powder (or Carbonyl Particles).—A metal powder prepared by the thermal decomposition of metal carbonyl.

Chemical Deposition.—The replacement or precipitation of one metal from a solution of its salt by the addition of another metal or reagent to the solution.

Coining.—See sizing.

Cold Pressing.—The forming of a compact at room temperature.

Comminution.—See pulverisation.

Compact (synonymous with *Briquette*).—An object produced by the compression of individual, mixed, or alloyed metal powders with or without the inclusion of non-metallic constituents.

Compressibility.—The property of a metal powder mass to yield under pressure.

Compression Ratio.—The ratio of the volume of a loose powder to the volume of the compact after application of a specified pressure.

Continuous Sintering.—Pre-sintering or sintering in such a manner that the objects are advanced through the furnace at a fixed rate by manual or mechanical means.

Core Rod.—A member of a die assembly used to produce a hole in a compact.

Cored Bar.—A compact of bar shape heated by its own electrical resistance to a temperature high enough to melt its centre.

Cut.—That portion of a powder sample which lies between two stated particle sizes or two screen-mesh sizes.

Dendritic.—Metal powder particles, usually of electrolytic origin, having the typical "pine tree" structure. (Also sometimes called *arborescent.*)

Density Ratio.—The ratio of the apparent density to the theoretical density of a solid mass of the powder.

Die.—The part or parts making up the confining form in which a powder is pressed.

Die Insert.—A replaceable liner for a die.

Die Set.—The parts of a press that hold and locate the die in proper relation to the punches.

Disintegration.—See pulverisation.

Dust.—The portion of a powder sample which passes a 325-mesh screen.

Electrolytic Deposition.—The production of a metal from a solution of its salt by the passage of an electric current.

Flake.—Flat or scale-like metal powder particles whose thickness is very small compared to the other dimensions.

Flow Characteristic.—The rate at which a metal powder will flow through an orifice in a standard instrument and/or according to a specified procedure.

Galling or Seizing.—The impairment of the surface of a compact and/or of the die parts due to friction.

Granular.—A formation of metal powder particles in approximately equi-dimensional non-spherical shapes.

Granulation.—The production of coarse metal particles by pouring the molten metal through a screen into water or by violent agitation of the molten metal while solidifying.

Growth.—The increase in dimensions of a compact which occurs during the sintering.

Hot Pressing.—The simultaneous forming and heating of a compact.

Impregnation.—The process of filling the pores of a sintered compact, usually with a lubricant.

Intercommunicating Porosity.—That type of porosity in a sintered compact in which the pores are intentionally connected so that a fluid may pass from one to the other or completely through.

Irregular.—The lack of symmetry or irregularity in metal powder particles.

Lower Punch.—The lower member of a die assembly which forms the bottom of the die cavity. It may or may not move in relation to the die.

Lubricating.—Mixing with or incorporating in a powder some agent to facilitate pressing.

Matrix Metal.—The lower melting point metallic constituent of a powder mixture which melts during the sintering operation and functions as a cementing medium.

Mesh.—The screen number of the finest screen of a specified standard screen scale through which all of the particles of a powder sample will pass. Frequently, but not necessarily, a part of the sample may pass finer screens.

Mesh Fraction.—That part of a metal powder passing a specified mesh screen and retained by some finer stated mesh.

Milling.—The mechanical treatment of metal powder or metal powder mixtures, as in a ball mill, to affect the size or shape of the individual particles, or to coat one component of the mixture with another.

Minus Mesh or Through.—The portion of a powder sample which passes through a stated screen. (See *Plus Mesh.*)

Mixing.—The thorough intermingling of particles of two or more powders. (Same as *Blending.*)

Needles.—Metal powder particles of elongated form resembling a needle. (A needle-like structure is called *Acicular.*)

Nib.—A pressed, pre-sintered, shaped, sintered, hot pressed, rough drilled or finished compact. Also: A generic term used for a piece of hard carbide material intended for use as a drawing die.

Nodular.—The knotted, rounded, or other similar shapes observed in metal powder particles.

Packing Material.—Any material in which compacts are embedded during the pre-sintering or sintering operation.

Particle Size.—The controlling lineal dimension of an individual particle as determined by analysis with screens or other suitable instruments.

Particle Size Distribution.—The percentages expressed in terms of weight of the various sizes of particles in a powder sample when classified in terms of size ranges, and measured in terms of screen mesh or microns.

Pill Press.—A pharmaceutical pill press adapted to form compacts.

Plates.—Flat particles of metal powder having appreciable thickness.

Plus Mesh or Oversize.—The portion of a powder sample retained on a screen of stated size. (See *Minus Mesh.*)

Pore.—A minute cavity in a compact formed either intentionally or unintentionally.

Porosity.—A multiplicity of pores in a compact, usually distributed uniformly.

Pore Forming Material.—A substance included in a powder mixture which volatilises during sintering and thereby produces a desired kind of porosity in the finished compact.

Powder.—Particles of matter in which the size and characteristics are of such an order as to make the material of use in the formation of compacts.

Pre-Sintering.—The heating of a compact at a temperature below the normal final sintering temperature, usually to increase the ease of handling or forming the compact or to remove a lubricant or binder prior to sintering.

Press.—A machine used to form a compact by pressure.

Pressed Bar.—A compact in the form of a bar.

Pressed Density.—The weight of a unit volume of powder which has been pressed into a standard test-piece of finished compact at a designated unit pressure.

Pressing.—The forming of a compact under pressure.

Pressing Crack.—See *Slip Crack.*

Puffed Bar.—A cored bar expanded by internal gas pressure.

Pulverisation.—The reduction of metal to fine powder by mechanical means. (*Disintegration* and *Comminution* are terms also used.)

Rate of Oil Flow.—The rate at which oil will pass through a sintered porous compact under specified test conditions.

Roll Compacting.—The progressive compacting of metal powders by the use of a rolling mill.

Rolls.—A machine used to apply pressure progressively to form a compact.

Scale.—The layer of oxide which is formed on metals when heated under oxidising conditions.

Segment Die (or *Split Die*).—A die made of parts which can be separated for the ready removal of the compact.

Seizing.—See *Galling.*

Shot.—Metal powder particles of spherical shape, usually solid.

Shrinkage.—The decrease in the dimensions of a compact which occurs during sintering.

Sintering.—The heating of metal powders or compacts to convert them into coalesced, alloyed, brazed, or welded masses, under controlled conditions of time, temperature, and atmosphere.

Sintering Furnace.—A furnace used to heat metal powders or compacts during the pre-sintering or sintering operations. The heating and subsequent cooling may be carried out in a controlled, inert, or reducing atmosphere, or in a vacuum.

Sizing or *Coining.*—A final pressing on a sintered compact to get desired size or physical properties.

Slip Crack or *Pressing Crack.*—A rupture in the pressed compact caused by the mass slippage of a part of the compact.

Specific Surface.—The surface area of one grain of powder, usually expressed in sq. cm.

Spherical.—Metal powder particles of spherical shape which may be either solid or porous.

Split Die.—See *Segment Die.*

Spongy.—A porous condition in metal powder particles usually observed in reduced oxides.

Sprills.—Metal powder particles of cylindrical form, not much larger than their diameter.

Stripper Punch.—A punch which, in addition to forming the top or bottom of the die cavity, later moves further into the die to eject the compact.

Superfines.—The portion of a powder sample which is less than 10 microns in size.

Sweat Out.—The low melting constituent of a compact which melts during sintering and subsequently appears on its surface.

Tap Density.—The apparent density of a powder obtained when the volume receptacle is tapped or vibrated during loading.

Upper Punch.—The member of a die assembly which moves into the die to transmit pressure to the powder contained in the die cavity.

Void.—An unintentional empty space in a sintered compact.

Coal-Tar Pitch for Incendiaries

New and effective methods of extinguishing magnesium fires in commercial plants have been developed by the U.S. Bureau of Mines. Designed for places where magnesium is handled continuously, the method is equally effective on incendiary bombs. Hard coal-tar pitch in granulated or flaked form is highly satisfactory, the pitch forming an airtight blanket, smothering the flame. This method is considered superior to the use of sand or water or prepared compounds, such as carbon tetrachloride, carbon dioxide or foam.

Developments in Vitreous Enamelling*

REVIEW OF CURRENT TRENDS—NEED FOR CLOSER CO-OPERATION BETWEEN FOUNDERS AND ENAMELLERS —POST-WAR PROBLEMS

By JOHN W. BAILEY

In contributing this Paper it is hoped there will be something of interest to the foundrymen present. It is the earnest desire to help in the co-operation that should exist between foundrymen and enamellers which by virtue of their respective efforts should produce a combination of strength and beauty. There may be nothing new in this Paper from that which has already been said, but developments on enamels have many viewpoints concerning:— (1) Construction or design; (2) finish; (3) durability of finish, and (4) efficiency.

The war has brought with it many problems for the enamellers and enamel manufacturers, and the solving of these will help technicians to produce better enamels and better enamelled articles in the future.

Unfortunately these problems may not be of the same educational value to us as the problems which workers in the allied trades are surmounting. The workers in non-ferrous metals and in stainless steels are fully occupied, and are constantly improving the quality of their products in the ease of manufacture and the lowering of production costs. This is, in so far as the enameller is concerned, competition of a kind which has got to be guarded against after the war from metals made "stainless" by methods other than enamelling and also from moulded resins, loosely known as "bakelite," although "bakelite" is actually the trade name of one form, which has many competitors.

The obvious advantages of enamelling such as beauty of finish achieved by colour, allied to either high gloss or "satin" matt finishes, resistance to acids, alkalis, and abrasion, will have to be emphasised by an advertising campaign financed jointly by the industries.

Every effort must be made both by the enamel producers and enamellers to overcome the possibility of defects in vitreous enamel finishes which are so eagerly pounced on by competitors. Wherever the industry offers or introduces a vitreous enamelled finish to new users it must be sure that the finish offered is suitable and can be reproduced at a minimum cost; such costs are going to be a serious post-war problem in meeting non-ferrous competitors, who will be looking for markets previously unexplored, and, as already explained, they have a present advantage by being on 100 per cent. output; thus their costs, rather than being on the increase, will be on the wane.

Costing is the specialist's job, and on statistics has proved its value, but unfortunately in many foundry-enamelling plants, costs have been taken departmentally, beginning with the foundry by producing castings at so much per cwt., regardless of the cost entailed by the enameller to produce the finished article. Departmental costs, whilst not being generally favoured, are essential in making each department responsible for its own shortcomings.

Vitreous Ground Coats

Coming to details of the various processes where recent developments are of interest, the first obvious consideration is the enamelling of cast iron by the wet process. All enamellers are familiar, of course, with the developments of leadless enamels during recent years, with the complete elimination of lead from the wet process enamels, and the general displacement of matt ground coats, in favour of the direct application, except in the cases of heavy lugs and uneven thickness.

The ideal enamel has not been attained so long as the industry continues to use a matt ground coat, which is not completely vitreous. Present-day matt ground coats are very much nearer being vitreous than those used a few years ago, and give excellent covering of the iron with good adhesion. No doubt in some cases it is not possible to produce a casting suitable for enamelling by "direct wet process," even using a vitreous ground coat as perhaps in the case of castings which serve the purpose of heat conservation, but there are still many instances where ground coat could be eliminated if the proper co-operation existed between the enameller, foundryman, and designer.

A New Flux

A comparatively recent development is the production of a special flux for use in the cupola which acts as a refining agent much stronger than by using limestone alone. For many years the use of soda ash (anhydrous sodium carbonate) as a special flux for addition to the usual limestone has been followed with outstanding success in progressive foundries. The cleaning action, however, is very often carried out after the metal has left the cupola spout, and in many cases any initial beneficial treatment in the cupola is ignored.

The usual operation entails the use of special ladles, if it is to be done in a really satisfactory manner, and the further addition of broken limestone is recommended in order to coagulate the liquid slag produced by the soda and ferrous/manganous silicates. In continuous melting and production, however, the time factor for reaction is a consideration demanding control.

Where desulphurisation is the major aim of the process, the time allowed between additions and slag removal is all important, as the desulphurising reaction is reversible. On similar lines, the alkalinity provided by the soda must on no account be unnecessarily neutralised by silica, of which sand is a form, and which is chemically acid in character. It is for this reason that limestone, which is chemically basic in character, is added for the purpose of coagulation or thickening of the liquid slag.

Whether used in the cupola charge or in the ladle, the soda ash suffers decomposition, the essential base being represented by the residual 58 per cent. of sodium oxide, the balance of 42 per cent. being liberated as carbon dioxide gas. While there is no question in regard to the furnace or ladle providing sufficient temperature for refinement of the soda ash, the factor of the time period during which the gas must be substantially removed is an important consideration.

Workers conversant with the preparation of vitreous enamel frits are aware of the time required for temperature to permeate a raw batch, and the slow rate of gas evolution. It is not claimed that the calcination of limestone (calcium carbonate) or soda ash (soda carbonate) during descent in cupola melting is completely analogous to the example of frit making. It can be observed in common practice, however, that cupola slags are often frothy, due to incomplete calcination. These frothy slags are associated with ineffective cleansing of the metal.

No one knows better than the enameller the trouble entailed in trying to produce a vitreous enamel finish on a casting that is unsound, all the annealing and shot-blasting does to a casting of this type is to increase the porosity, and, if successful, achieving a vitreous finish, has also undoubtedly succeeded in trebling costs, whereas the foundryman sold his casting in the first instance at the specified shillings per cwt.

The cost of the special flux can be offset by an increased percentage of scrap content to the foundryman, to the enameller, lowered rejects through porosity which causes blowholes and blisters, lowered costs of cast-iron filler, lowered costs on annealing and shot-blasting, and finally that which the sheet-iron people have been striving for years at a cost comparable with the lower grade of metals, an enamelling iron.

Acid-Resisting Enamels

The enamellers' lot could be made much easier and more castings enamelled by the "direct application" in pastel shade and acid-resisting enamels. Why do the enamellers fight shy of acid-resisting enamels? Information gathered from various plants conclude with the same complaint, the iron is unsuitable.

In so far as acid-resisting enamels are concerned, present day manufacture of these are on a par with the ordinary wet process enamel, but the mention of acid-resistance seems to be a kind of bogey with the general enameller, yet stewpans and cast-iron hollowware generally have to be specified "A.R.," and is being done daily, in direct application, with a scrap rejection of 1 to 2 per cent.

Generally, gas and electric cooker castings should not present any difficulties in so far as acid-resisting enamels are concerned if attention has been given by the designer to the coring out of heavy lugs, uniform thicknesses, and a radius given instead of the "knife edge" so popular in the cooker casting of 10 or 12 years ago.

Physical Condition of Frits

The enameller must also give more attention to the grinding fineness, viscosity, and application. Grinding fineness by many people even to-day is taken by the old rule of the thumb. This is wrong. How can any man tell how many grains there are in a pinch of snuff?

* A Paper read before a joint meeting of the Falkirk section of the Institute of British Foundrymen and local members of the Institute of Vitreous Enamellers, Mr. Thos. Tyrie presiding.

Developments in Vitreous Enamelling

Fineness, which is an essential factor for consistency of colour, coupled with correct temperatures, can only be strictly maintained when tested correctly. Viscosity, that property of a liquid which determines its rate of flow, must be the same to-day as yesterday and for to-morrow.

Application is governed chiefly by the two mentioned factors, so don't blame the operatives every time if there is loss of colour, patchy work, lack of gloss, but look to the milling room first for the faults. For stoves, the grey and white mottle finish may not again be accepted by the public as standard finish. Plain colour finishes are now associated with the higher class productions, and will probably be demanded as a standard finish when the public re-furnish. Public taste is fickle and changes easily, but can very often be led, and a finish which would give a lower percentage of rejects in the enamelling shop would probably be accepted, provided that it is "new" to the public and a change from the old standard mottle.

It costs very little more to produce light and dark green mottle, light and dark blue mottle, shading light and dark colours, marbling, etc., than grey and white mottle, providing that the frits belong to the same family.

Any scheme might present itself to a manufacturer, and perhaps, maybe, cannot be developed in his own shop due to colour changes and the like, but remember the supplier of raw materials is always willing to help and is as anxious for new developments as the enameller. There will undoubtedly be strong competition from the sheet iron fabricated stoves. In this case the production of self-coloured and pastel coloured acid-resistant finishes does not demand the same degree of increased vigilance and cost as applies to cast-iron.

Rain-Water Goods and Road Studs

Rain-water pipes in the past a "cut throat" line, may be raised to a new level by a vitreous enamel finish, but here again a noticeable improvement in the quality of the castings, particularly in the reduction of "blowholes," will be necessary, although an excellent finish has been produced on a comparatively poor casting by the use of a completely "vitreous" ground coat and cover coat. In the case of enamelled cast iron for use outdoors it will be essential that the enamel used has the necessary weather resistance.

Enamelled road studs, both white and yellow, have been satisfactorily produced, the possibility and development of this under the present rubber situation should be taken up immediately by the people interested. White road lines have also been produced with good results, together with kerb stones in alternative colours of black and yellow; this combination has been proved very beneficial during "black-out" periods.

Developments in wet-process for cast-iron enamels have proceeded by stages. First, the production of an easy working enamel which would give a satisfactory finish on medium quality castings of various thicknesses; secondly, a similar enamel but with a greater latitude in production, more latitude in grinding fineness, speed of drying, temperature, and time of fusing.

Acid- and Alkali-Resisting Enamels

Then came the demand for increased resistance to acids and alkalis, when it became necessary to revert to more careful control of the enamel grinding and application, and more important still, the standard of casting quality which had been allowed to deteriorate as enamels became easier to apply, needed raising again. The resistance of enamels to alkalis is not stressed as often as acid resistance, but it is often at least of equal importance. For instance, large buyers of stoves, such as the various Corporations, hire out a large proportion of their stoves, which are periodically recalled, cleaned, and then degreased, usually in strong alkaline solutions; furthermore, many household cleaners are strongly alkaline, all of which has a definite action on some types of enamel. Acid-proof wet-process enamels are often only moderately resistant to alkalis. Therefore, to all concerned, the best enamel for stove work is that which is easily worked and reasonably resistant to both domestic acids and alkali cleaners.

Enamelled Fireplace

In the case of such articles as electric fires, fireplace surrounds, etc., the vitreous enamel finish has to compete with the synthetic enamel finishes with glaze effects. Surprisingly little use has been made of the vellum or satin vellum finishes in vitreous enamel, yet they can be produced at as low a cost as bright surfaces. The glazed tile manufacturers have specialised almost entirely of recent years on matt, or satin matt finishes, relieved by a "marbling" effect with a glossy finish. At the present time, the tile industry is short of work, and on the resumption of building activity the producers of cast-iron hearth surrounds will have a distinct advantage if they are quick enough to seize it, particularly if their designs and colour schemes are attractive and they emphasise sufficiently the definite advantages of permanence and freedom from "crazing."

Prior to the war the tendency of taste was away from the more vivid colour schemes to single self-colour pastel effects, or even towards plain black-and-white contrast, but these years of enforced "black-out" conditions and general darkness must inevitably lead to a reaction towards bright colour effects and contrasts. A development which did not receive the attention deserved was the production of a dry-process leadless black enamel particularly suitable for frets at a price which made the dry process finish competitive with the wet process, with the added advantages of a far superior colour and freedom from "sulphurising" or scumming, which is a possible source of complaints when wet-process "black" is stored in a damp atmosphere. A similar enamel was produced in a range of colours to match the standard tile finishes, and a comparatively high price can be obtained for these special frets which well repays for the extra attention. These enamels in the various colours are also very suitable for electric fires.

The Bath Position

In the case of dry process enamels for baths, there has been a similar dual demand, first for an easily working enamel, easily fusible with good gloss and opacity; then, secondly, for an enamel with similar ease of working, but with a resistance to acids and alkalis. This question of resistance is particularly important in the case of coloured bath enamels, as a loss of surface gloss below the "water line" of the bath gives a very different colour. As for coloured baths, it would be very helpful to all concerned if the representatives of the enamellers and potters could meet to decide on a range of standard colours, together with a decision as to the range of tolerance permitted. The potters have considerable difficulty in maintaining a standard tone, and because of the different results obtained on sample buttons as compared with actual production, it is advisable to use as a standard an actual production piece.

Standardisation could still permit a wide range of colours to suit individual tastes, and the desire for "something different," but as an example of the chaotic state which the coloured bath enamel trade had drifted into shortly before the war, the industry was carrying in stock, and supplying regularly, no less than 50 shades of green leadless bath enamels, and 40 shades of ivory, primrose and amber. Sheet iron baths have not been marketed on a commercial scale in this country, but on the Continent and in the U.S.A. they constitute a definite proportion of enamelled bath sales. Of passing interest, it was a Scotsman who enamelled the first bath in the U.S.A.

Developments of sheet iron enamelling have mainly been directed towards the replacement of castings; so much so, that the cabinet types of gas and electric cooking stove were gaining in popularity. Consisting mainly of fabricated sheet iron, they have been sponsored by the larger firms, as the installation cost of the necessary tools is comparatively high. There, again, will post-war measures bring conversion of those presses now doing essential war work, to the manufacture of sheet iron cookers? If so, then the foundryman must look to his laurels, as the total cost of a complete acid-resistant cooker will be no more than two-thirds of the cost of the present cast iron/sheet iron cooker, which in many instances is not acid-resistant.

Developments in the sheet iron enamels are perhaps not so noticeable as in the case of cast-iron enamels. In ground coats, the main object has been increased reliability, freedom from copperheads, fishscaling and re-boiling, and an interesting requirement is for a special ground coat to withstand reheating to high temperatures in the ovens of electric cookers, where the elements are fitted almost flush to the linings.

In cover coats, reduced costs have been made possible by means of improved frit opacity, giving lower milled enamel costs by reduction of opacifiers at the mill, and maximum opacity by the application of thinner coats has been a noticeable feature.

The value of super-opaque enamels is governed to some extent by the standard of enamel shop supervision. Thinner cover coats require a higher quality ground coat finish; otherwise ground coat defects are not covered, and, because of percentage of rejects due to faulty application, faulty handling, or faulty fusings, one coat (white) is not a satisfactory commercial proposition, unless a standard procedure can be adopted and rigidly maintained by careful supervision throughout the processing.

Architectural Work

The architectural use of vitreous enamelled sheet iron has been comparatively small in this country up to now, but there will undoubtedly be a big market in this field, provided suitable enamels are chosen, and that a high standard of inspection is maintained, so that there is no possibility of prejudice to vitreous enamel because of failures which could have been avoided. We have had very much more experience in this type of work in this country than is generally realised, and the following particulars actually carried out by a colleague will no doubt be of interest.

The enamelling of the body and roofing of steel railway coaches has been successfully carried out. Particularly where these coaches are in service under climatic conditions where paintwork rapidly deteriorates, have they proved economical and remained in service, whilst coaches finished with the normal paint and varnish have been idle for months in workshops where it has been necessary to take them for re-painting, but it should be noted that the successful enamelling was only made possible by the close co-operation of the steel manufacturers and the enamellers, for, however perfect enamel may be, if applied on a poor foundation, successful enamelling cannot be achieved. One of the difficulties which arose was how the plates, when enamelled, were to be attached to the body frame to avoid chipping, and various experiments were made with bolts, solid rivets, split rivets and drilled rivets, and finally the drilled rivets were used with thin lead washers under the heads. The rivet heads were first enamelled, and thousands of these were

Developments in Vitreous Enamelling

used successfully, which again shows what can be done with a little co-operation.

Panelling with vitreous enamelled sheets has also been used for lining the lavatory compartments of railway coaches, and thousands of these have been in service for many years. It may not be known by many people that millions of enamelled steel tiles have been fixed on the underground railways of London, and this form of exterior decoration has been extensively used in America on petrol-filling stations and similar buildings.

The development of enamelled steel for domestic purposes has progressed, whilst, comparatively speaking, the enamelling of cast iron has stood still. This may be due to the lack of appreciation by the foundries of the enormous field which is open to them, and the public demand for beauty in the home, as well as utility.

DISCUSSION

The subsequent discussion was opened by the Chairman (MR. THOS. TYRIE), who expressed his interest in Mr. Bailey's contention, that future demand would be for self-coloured enamels, since he himself quite honestly believed that mottled enamels more or less owed their origin to the desire for a method of covering small surface defects, and thereby eliminating a large percentage of rejects. Distinction was necessary between alkali resistance and acid resistance. He (Mr. Tyrie) had experienced a case where baths had been enamelled in very good quality acid-resisting enamel, yet complaints were received that the baths were suffering from severe wear. Close investigation had shown that the trouble had arisen through the use of strongly alkaline cleaners, consisting of a high percentage of an abrasive, such as pumice and soda. Mr. Tyrie also expressed interest in the developments in connection with the application of vitreous enamels to architecture. Great advances had been made in America in this line, whilst the British applications, too, were interesting.

MR. BAILEY said that initiative was necessary in order to take up the case of the enameller in the post-war years. He agreed with Mr. Tyrie's remarks on mottling. In his opinion, bakelite type products and stainless steels were definitely proving strong competitors of the enamelling process. To combat this, much research would be necessary in preparation for the post-war years.

Anodised Aluminium

MR. J. A. DONALDSON (Carron), in congratulating Mr. Bailey on his Paper, said that he was inclined to add anodised aluminium products to those competitors of vitreous enamel. His personal opinion, however, was that by virtue of its two main characteristics, heat resistance and acid and alkali resistance, vitreous enamel had little to fear from these other finishes, provided that there was co-operation between the various people concerned with its production. Possibly the gratefounders of the post-war years will require to meet opposition from the manufacturers of tiled fireplaces, but this also could be minimised by more attention being paid by the foundryman, in order to arrive at a surface comparatively free from defects. Similar remarks applied to the threat of competition from the all-sheet metal cooker.

Glass-Lined Tanks

MR. WM. MONTGOMERY (Leven) remarked that he would have liked to have heard more about the potentialities of acid-resisting enamels, that is where the enamels would resist all but the strongest acids, such as hydrofluoric and phosphoric acids, and very strong alkalis. He believed that there was a very great future for such an enamel. Naturally in acid resisting work all operations from smelting to application requires more rigid scientific control. Castings also required greater care in manufacture. He was also interested in Mr. Bailey's remarks on the new pre-calcined flux, as inner cleanliness was a very strong point in the enamelling of cast-iron goods. Further, he could not believe that there was a really alkali-resisting enamel, since all enamels contained a large percentage of SiO_2, and could not therefore be truly alkali-resisting. An example could be given in the removal of the substance known as " beerstone " from the enamelled beer storage tanks, by the use of a strong alkali.

MR. BAILEY, in reply, said that he had spoken of acid-resisting enamels in relation to general domestic ware. The case of the beer storage tank was a matter of the dry process of enamelling.

MR. MONTGOMERY refuted this suggestion and maintained that the case in question was one of wet-process enamelling on steel. He agreed that all acid-resisting work required very strict supervision.

MR. R. R. SHAW (Larbert) mentioned how as he was not an enameller, the full significance to him of Mr. Bailey's Paper lay in the application of vitreous enamels to architectural work such as the protection of rainwater goods, such as gutters, etc. He wondered if it was a practical proposition, that is, would the saving in the cost of dipping and painting offset the initial cost of the enamel coating? There were three points on which he hoped Mr. Bailey would give him further enlightenment, namely: (1) As the present gutter was usually in a very rough state, would this permit of satisfactory enamelling? (2) Was the initial cost a very important factor? and (3) Would there be any difficulty in overpainting the enamel where a change in the colour scheme was desired?

In reply, MR. BAILEY said: (1) The present gutter was definitely unsuitable, so that the foundryman would require to produce a much smoother surface; (2) it was not necessarily more expensive to instal vitreous enamelled gutters. One coat direct application vitreous enamel was very much cheaper in the long run; and (3) no difficulty should be experienced in overpainting enamelled gutters, as they would present infinitely better surfaces than in the case of the plain cast variety.

MR. SHAW said that as it would be difficult for the ironfounder to alter the moulding procedure in gutter manufacture in order to introduce facing sand, therefore although the surface be not perfect, would it not be worth while to enamel this, so that although not a 100 per cent. job it would be fairly resistant to corrosion?

MR. TYRIE, commenting on this last statement, said that the ironfounder who proposed to enamel the inside of a pipe or gutter, and did not get complete continuity in the enamel, would find that electrochemical corrosion would soon wear away the pipe. A similar result could be obtained with painted or galvanised finish, because of localised pitting set up through the establishment of an electro-motive force.

MR. MONTGOMERY asked why, if a few pinholes could result in the destruction of the pipe, an electric test could not be made, and continuity arrived at by filling up imperfections with A-R. cement. Referring to single coat dry-process work, the criterion of a good job was a surface free from such defects as sand grains.

MR. BAILEY said that there was some controversy as to what degree of smoothness was actually desirable. Direct application meant a solitary colour coat applied to the iron, and fired to complete the finish.

MR. TYRIE said that there were instances in this country of enamelled gutters being used on buildings where easy access was not possible. There was usually trouble due to unsoundness around the flat gates.

Both MR. DONALDSON and MR. G. C. WILSON (Camelon) suggested that the trouble in enamelling gutters arose through the fact that the moulder was paid to supply a certain quality of casting, but was also expected to provide a surface suitable for enamelling for the same price. The much-prized " blue finish " was not altogether desirable for enamelling, as invariably it was accompanied by sub-surface defects.

MR. BAILEY agreed, saying that too often the enameller was asked to accept for enamelling, castings made on the basis of so many shillings per cwt.

MR. R. URE (Carron) asked whether the sheet iron bath had a longer life than the cast-iron one, and was answered in the negative.

MR. MONTGOMERY cited a case where cast-iron pans had given trouble. This was found to be due to chlorination of the enamel. The pans were enamelled in acid resisting quality, but had to withstand attack by free chlorine, and hydrochloric acid in a moist atmosphere.

MR. TYRIE, in closing the discussion, spoke in support of enamelled cast-iron grates, in the face of competition from tiled grates, and said that in view of examples he had seen in local works, he had no hesitation in saying that cast-iron grates would hold their own in the post-war years. Thereafter he proposed a vote of thanks and appreciation to Mr. Bailey for addressing the meeting, and this was carried with acclamation.

Mr. Bailey suitably replied, whereupon the meeting was declared closed.

Welding Magnesium Castings

The researches of Klaus Grassmann and Johannis Brandis (Z. f. Metallkunde) have been abstracted by " Metals and Alloys." It is stated that the preheating ranges for gas welding and arc welding are 250 to 350 deg. C. and 280 to 300 deg. C., respectively. On castings of not too complicated a design, 75 per cent. good welds were obtained at 200 deg. C. and 50 per cent. at 95 deg. C. It was found necessary to preheat the casting uniformly and to continue heating (rising hot-air current, sand-bath) during welding. Cooling should be slow and free from drafts. In comparison with aluminium, magnesium requires only one-third of the heat for melting the welding rods, three-quarters of the heat for raising the temperature of the liquefied weld, and more time for solidification, as the thermal conductivity is only two-thirds that of aluminium.

For arc welding, one electrode should be carbon. Illustrations are given of a casting of 0.20 in. thickness welded with a $\frac{1}{2}$-in. dia. carbon electrode at currents varying from 25 amps. to 280 amps. The optimum range is 50 to 60 amps. When using a 0.20 in. carbon electrode, the best results were obtained at 90 to 150 amps. The amperage was less critical with jobs of 10 to 30 mm. wall thickness; 70 to 95 amps. is sufficient in this case, using a $\frac{1}{2}$-in. carbon electrode. It is impossible to weld large wall thicknesses with thin carbon electrodes. Using carbon electrodes larger than $\frac{1}{2}$ to $\frac{5}{8}$ in. dia. offers no advantage even with heavy cross sections. The best current densities are 0.5 to 1.0 amps. per sq. mm. and 4.5 to 7.1 amps. per sq. mm., respectively, for $\frac{1}{2}$-in. and 0.20-in. carbon electrodes. Diagrams show the necessary welding time for different sizes of Mg and Al welding rods.

In gas welding, small tips are used, much smaller than for aluminium. Either a neutral flame, or an excess of gas is advised, in addition to the use of the shortest possible welding times. With the fluoride-base fluxes, porosity around the weld may be suppressed. The liberated fluorine vapour seems to prevent oxidation. For aluminium-bearing magnesium alloys (up to 10 per cent. Al), solution-annealing of welded parts can be effectively carried out. Statistical evaluations show that samples including the weld are 5 to 15 per cent. lower in tensile strength than samples taken from the adjacent areas of the unwelded, finely porous parent metal. Yet the fracture is mostly outside the weld. Fatigue bending tests give an average of 8 to 10 per cent. lower values for welded than for unwelded material.

Cupola Practice*

BY DONALD J. REESE

A portion of the increased hourly and total tonnages may be attained by narrowing down the variations in practice which foundrymen have put up with in the past. Demand that the coke supplier maintains the quality of his product, then aid him in meeting his commitments by applying all the means of fuel conservation available. Buy a "sized" coke of one-twelfth the cupola diameter in size. Weigh the coke charge accurately. Use 10, 9 or 8 lbs. of coke per sq. ft. of cupola area and not 20, 25 or 30 lbs. per sq. ft. A proper height for the coke bed in inches of coke above the main tuyeres is $10.50 \times \sqrt{P} + 6$. P is the wind-box pressure in ounces, so with a 16-oz. pressure, the bed height should be 48 in. Do not forget that a successful day's run begins with a properly "burned-in" coke bed. Hot metal on the first tap is dependent on sufficient soaking time to preheat the sand bottom and well refractories. An hour's time between light-up and wind-on is "too" little soaking time. Good results are obtained when the bed soaks as much as 5 or 6 hrs.

Avoid wasting this high-quality metallurgical fuel in shop salamanders, to preheat ladles, to vent cores, to bake cores, etc. With 30, 50 and 70 per cent. steel in the cupola charge, the carbon levels in the iron should be 3.05, 2.70 and 2.35 per cent. respectively. The main reason for using steel in the cupola charge is to attain desired carbon levels, though it also helps to attain high metal temperatures (above 1,535 deg. C.) and lowers the phosphorus content in the iron. Steel scrap is deficient in silicon, and each ton of steel used unnecessarily requires about 40 lbs. of silicon to make the product grey and machinable. The supply of both steel scrap and silicon needs to be conserved to the best of one's ability.

Plan the metal distribution so that only the right amount of metal goes to the pouring floor and that ladles are completely emptied before receiving a new supply of metal. See that metal reaches the pouring floor in the least possible time after it is tapped from the cupola. It is good practice to weigh this metal if it is at all possible to do so.

Cupolas work best when the melting rate is greater than 1,500 lbs. per sq. ft. per hr. and up to 2,250 lbs. Successful operation becomes increasingly difficult as the melting rate approaches 750 lbs. per sq. ft. per hr. If the cupola is melting slower than 1,500 lbs. per sq. ft. per hr., speed it up by using more air, or if the moulding floor cannot handle the higher hourly output, line down to a smaller diameter.

Plug up leaks in the air circuit between the blower and the melting zone of the cupola and do not overlook the large air loss through an oversized slag hole. Air losses may exceed 20 per cent. of the air delivered by the blower. If the plant is worked by a fan-type blower, do not cover the intake with a screen finer than 1-in. mesh.

The charging gang has the important job of controlling the chemistry of iron. All materials going into the cupola must be weighed accurately and as the charge was calculated. Do not waste time worrying about tuyere area, oxidised metal, cupola pressure, etc. Have courage to use materials that were formerly considered unsatisfactory for a cupola material, provided the chemistry and linear dimensions are satisfactory; 30 per cent. of the cupola diameter is a satisfactory linear dimension.

Remember that the cupola is a high-speed melting unit, and to evaluate its performance in

(*Continued in last column.*)

* One of a series of short articles appearing in "Metals and Alloys," covering the general subject of speeding up munitions production.

(*Concluded from first column.*)

pounds of iron melted per minute or per second is a measuring stick leading to better knowledge of its performance. Do these things:—

(1) Size materials to best suit your cupola.

(2) Accurately weigh all ingoing materials, and, if possible, outgoing iron.

(3) Conserve fuel, silicon and steel scrap.

(4) See that the coke bed is burned through properly and that it soaks more than 2 hrs.

(5) Melt 1,500 lbs. or more per sq. ft. per hr.

(6) Plug up all air leaks, including the unnecessary amount through the slag hole.

(7) Expedite metal handling and do not store more than a 12- to 15-min. supply in reservoir ladles.

(8) Preheat ladles to a white heat if at all possible.

(9) Improve yield of good castings from total iron melted by eliminating need for pigging cold metal.

Cleveland Ironstones

REVIEW OF CURRENT POSITION

The Jurassic iron ores of the Cleveland district are again surveyed in Wartime Pamphlet No. 23 by MR. W. ANDERSON, M.Sc., issued by the Geological Survey. The present publication brings up to date previous official reports. The author recalls that the term Cleveland district is used in the extended popular sense to cover all the hilly Jurassic country of Yorkshire north of the Vale of Pickering, and not merely the portion that lies north of the River Esk. Among the stratified iron ores of Britain, those of the Cleveland district take high rank, both in respect of output and industrial consequence. Almost the whole of the supply comes from the Main seam, which, with less important companions, occurs in the Ironstone Series of the Middle Lias. The exploitation of the Main seam began in 1850 near Eston. It rose rapidly to a great industry, and has since been continuous.

The typical ironstones of the district are oolitic chamosite-siderite mudstones, with practically no cementing calcite. The chamosite largely occurs in ooliths, about $\frac{1}{60}$ in. dia., which appear greenish-white, but vary to brown if containing siderite. These ooliths are often grouped in bunches, alternating with compact mudstone matrix of general dogger type, though usually richer in chamosite. The ironstone is firm, somewhat porous, grey in colour, and mottled with brown, due to the presence of siderite.

The principal inland outcrop of the Ironstone Series coincides with a bold escarpment that runs south-westwards from the coast near Saltburn to Roseberry Topping, a distance of eight miles, and thence southwards through Kildale. To the north of this scarp the series is repeated by the Upsall fault at Eston. Along the coast the outcrop reaches from Saltburn to Staiths, and then, owing to minor undulations, reappears at Runswick and Robin Hood's Bay. The Middle Lias is also exposed along the floors of deeply incised dales, running north and south from Glaisdale Moor. The general dip of the strata is south-eastward. The faults are usually too small materially to affect the mining of the ironstones, but the Upsall and the Lockwood Beck faults are of importance.

The author then considers the various seams in order, from below upwards, before dealing with the Main seam, which is the most important.

The Main Seam

The Main seam attained its maximum thickness and value as an ore at its north-westerly outcrop on the northern side of the Eston Hills, where it is now nearing exhaustion. Eastward, for about eight miles, to its termination near the coast between Saltburn and Skinningrove, the Main seam continues as a single bed, but its thickness diminishes to about 10 ft., workable, at Upleatham, and about 8½ ft. near the coast.

Southward from the outcrop, the Main seam maintains its homogeneity for two to three miles, and then becomes split into two portions, at first by a band of hard doggery ironstone, which still constitutes an ore, and afterwards by a parting of ferruginous shale, which is actually detrimental if smelted with the ore. The shale parting expands steadily southward at the expense of the ore, now divided into a Top Block and a Bottom Block, and the ore deteriorates in quality as well as in thickness. From the evidence of borings and from the study of the natural exposures, it is clear that the impoverishment southward and eastward continues progressively, so that in the Esk Valley and on the coast, south-east of Whitby, the seam has faded out of recognition, or is doubtfully represented by bands of nodules only.

At the end of 1939 the Main seam was the only bed of Cleveland ironstone which was being actively mined, and all workings were within the northern mining belt. All the exhausted mines lie along the northern edge of the mining belt; this is to be expected, for it is here that the Main seam was thickest, richest, and the nearest to the furnaces. To exhaust the seam within its present mining limits, 60,000,000 tons of ore may be obtained from the active mines, and a similar amount from the dismantled mines. The latter figure has been compiled assuming that all the stone in the abandoned workings is available, whereas a certain quantity may be lost owing to flooding and subsidence.

Throughout the district the seam is wrought pillar and bord, with some variations to suit local conditions. The shale is not separated where it is less than about 5 per cent. of the seam; however, as the seam rapidly thins with the oncoming of the shale, it is only in very limited areas where the band is not extracted from the ore. In places along the southern limit of working, shale formed as much as 35 per cent. of the wrought seam.

Whether or not workings to the Main seam will be made beyond the present southern limit is a matter which depends upon the future course of the iron industry as a whole. It would be futile to base any calculation upon the future relation between the cost of winning the ore and its market value. However, points on which there is definite knowledge are that the seam deteriorates in quality and thickness, and that the shale band rapidly thickens, south of the present mine workings.

Japanese Scrap Reserves

Scrap stocks of the Japanese steel industry at the start of 1942 may have been as high as 10,000,000 tons, sufficient to enable high armament production for many months to come, according to estimates by authoritative sources in New York, reports "Iron Age." The exact tonnage is unknown, but may be calculated by two different methods, which give similar results.

In the decade just ended Japan received about 11,600,000 net tons of iron and steel scrap from the United States, and produced nearly 56,000,000 net tons of steel ingots and castings, and about 30,000,000 net tons of pig-iron. Assuming that 90 per cent. of the Japanese pig-iron production went into steelmaking, the production of approximately 56,000,000 tons of steel required the use of 32,000,000 tons of scrap in the past ten years. This estimate of scrap consumption allows for the normal 10 per cent. loss of metal in the steelmaking process.

From steelmaking operations during the manufacture of finished steel from ingots, the industry in the past ten years should have obtained approximately 16,000,000 tons of scrap suitable for remelting. In addition, the Japanese had access to supplies of scrap accumulated by steel-consuming industries in fabricating steel products.

Applying the tonnage of purchased scrap consumed (using the American basis of purchased scrap equalling 40 per cent. of total scrap consumption) it appears that about 13,000,000 tons of scrap might have been recovered by the Japanese steel industry as purchased scrap from Japanese steel-consuming industries.

Meanwhile, during the past ten years, Japan imported about 4,600,000 net tons of pig-iron and finished-steel products from other steelmaking nations, and exported about 2,000,000 net tons of finished products. The net effect of this trade was to increase Japan's reservoir of scrap by at least 2,000,000 tons.

From the foregoing, experts reason that Japanese industry, through its own operations and through the importation of finished-steel products, created a total of about 30,500,000 tons of usable scrap during the past ten years. Since total scrap consumption during that period amounted to approximately 32,000,000 tons, it is held probable that the remaining 1,500,000 tons were made up by the use of scrap imported from the United States.

The authorities, therefore, conclude that the scrap stock of Japan at the start of 1942 was approximately 10,000,000 tons.

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Reports and Dividends

(Figures in brackets refer to the previous financial year.)

Worthington-Simpson—Dividend of 7% (same).

Short Bros. (Rochester & Bedford)—Ordinary and "A" ordinary dividend of 25% (27½%).

J. Samuel White—Interim dividend of 2½%, tax free, on the ordinary shares (5%, less tax).

Brown Bayley's Steel Works—Interim dividend on the ordinary shares of 5%, free of tax (same).

Westwood Dawes & Company—Net profit for 1941, £6,060 (£7,934); dividend of 15% (same); forward, £8,096 (£6,286).

Zinc Investments—Net profit to June 30 last, £12,691 (£766 loss); brought in, £7,109 (£14,125); dividend of 5% (2½%).

Wallsend Slipway & Engineering—Net profit for 1941, £84,929 (£90,252); final ordinary dividend of 8% (same) and a bonus of 7% (same), making 22% (same).

Clayton Dewandre—Profit for 1941, after providing for taxation, £36,237 (£41,937); to general reserve, £7,500; dividend of 10% (same); forward, £9,256 (£7,819).

Associated Electrical Industries—Net profit for 1941, £418,240 (£455,512); dividend on the ordinary stock of 10% (same), £246,092 (£283,006); dividend equalisation fund, £100,000 (same); preference payments, £52,306; forward, £285,314 (£265,472).

British Thomson-Houston—Profit for 1941, after providing for taxation, £559,776 (£572,516); to depreciation, £229,667 (£242,895); to general reserve, £100,000 (same); dividend of 7% (same) on the ordinary shares; forward, £217,413 (£196,310).

P. & W. Maclellan—Profit for 1941, after provision for taxation and contingencies, £40,655 (£52,500); debenture interest, £6,561 (same); to depreciation, £7,500 (£10,000); to reserve, £5,000 (£15,000); dividend of 6% (same); forward, £8,466 (£7,392).

John Baker & Bessemer—Profit for 1941, after tax to date, £81,731 (£78,712); provision for E.P.T. and for tax payable next January, £56,231 (£47,798); ordinary dividend of 10% (same); written off war damage insurance, £4,814; forward, £20,512 (£20,044).

Cammell Laird—Net profit for 1941, after providing for depreciation, debenture stock interest and sinking fund, taxation, deferred repairs and other charges, £186,548 (£241,852); ordinary dividend of 10% (same); to general reserve, £100,000; forward, £102,611 (£104,813).

International Combustion—Profit for the year to September 30 last, before providing for taxation, £197,769 (£198,677); to reserve for taxation, £75,000 (same); final dividend of 15% on the ordinary shares and a bonus of 10%, making 30% (same); forward, £29,635 (£21,376).

Cargo Fleet Iron—Profit to September 30 last, £170,743 (£118,415); interest on 4% debenture stock, £38,946; staff pensions, £6,182; sinking fund, £10,270; provision for taxation, £25,000; war damage contributions, £23,066; depreciation, £65,000; forward, £97,771 (£97,270).

Baldwins—Profit for 1941, after providing for taxation and deducting special expenditure at collieries, £341,645 (£360,411); depreciation, £150,000 (same); preference dividends, £51,312; dividend of 10% (same) on the ordinary stock, £124,737 (£144,487); forward, £54,272 (£44,516).

British Aluminium—Net profit for 1941, after making provision for taxation and debenture service, and after setting aside £50,000 to depreciation and £100,000 to reserve, £417,332 (£408,156); final dividend of 7% (same) on the ordinary stock, making 10% (same); forward, £222,128 (£194,796).

Beans Industries—Profit for the year to November 30, 1941, after all charges, £42,086 (£53,432); brought in, after transfer of £11,000 to tax reserve owing to increase of rate, £8,237 (£19,531); to war damage insurance account, £8,833; final ordinary dividend of 27½%, making 37½% (same); to pension fund, £2,500 (same); forward, £17,490.

Lancashire Dynamo & Crypto—Net profit for 1941, after charging £11,468 for depreciation and providing for income-tax, E.P.T., etc., £111,015 (£105,035); dividend on the cumulative preference shares at 5½%, £3,300; dividend of 15% (same) and bonus of 5% (same) on the ordinary shares, £80,000; staff pensions, £2,500; forward, £143,884 (£118,669).

British Insulated Cables—Profit for 1941, £810,385 (£786,232); depreciation, £247,324 (£209,622); directors' fees and works committee remuneration, £15,713 (£18,333); war contingencies, £100,000 (same); final dividend on the ordinary shares of 10%, making 15% (same) and a cash bonus of 5%, making 20% (same) in all for 1941; forward, £478,547 (£488,699).

Hadfields—Trading profit for 1941, after all expenses, maintenance, depreciation, and provision for taxation, £259,271 (£297,316); net profit, £198,904 (£259,621), after debenture interest, £13,757 (£20,918) for staff pension schemes, and £32,030 for war damage insurance; final ordinary dividend of 15%, making 22½% (same); forward, £659,022 (£588,167).

Gibbons (Dudley)—Net profit for 1941, after providing for taxation and depreciation, £26,623 (£24,835); 7% preference dividend (free of tax), £2,100; dividend of 10% (same) on the ordinary shares, £6,687; bonus of 2½% (same), £1,672; A.R.P., £2,000; written off buildings and plant, £3,000; to dividend equilisation fund, £2,500; to reserve, £5,000; forward, £17,504 (£14,741).

English Steel Corporation—Trading profit for 1941, after providing for taxation and contingencies and including income from investments, £862,347 (£912,497); depreciation, £500,000 (£400,000); net profit after debenture service, £280,024 (£430,246); preferred dividend of 7%, £78,012; deferred ordinary dividend of 17½% (20%), tax free, £197,946 (£226,224); to reserve, nil (£100,000); forward, £107,056 (£102,989).

Thos. Firth & John Brown—Net profit for 1941, after deducting debenture and mortgage interest and depreciation and making provision for deferred repairs and taxation, £307,236 (£390,822); preference dividend, £42,000; interim dividend on the ordinary shares of 4½%, free of tax, £69,750; war damage contribution, £30,500; final dividend on the ordinary shares of 5½%, free of tax, £85,250; forward, £156,190 (£141,453, less £65,000 additional tax on 1940 profits).

South Durham Steel & Iron—Profit to September 30 last, £281,134 (£188,576); interest on 4½% perpetual debenture stock, £13,500; interest on 4% debenture stock, £29,840; staff pensions, £3,619; dividend on 6% cumulative preference shares, £13,500; sinking fund, £7,500; taxation, £41,000; war damage contributions, £25,933; depreciation, £100,000; dividend on the 6% cumulative preference shares, £4,500; dividend of 6% on the ordinary shares, £21,000; additional dividend of 2% on the ordinary shares, making 8%, £7,000; dividend of 2% on the "B" ordinary shares, £11,757; forward, £122,865 (£122,717).

Organisation of War Production

An outline of the organisation he is setting up as Minister of Production was given by Mr. Oliver Lyttelton in the House of Commons last week. He said that he had been given the actual control of the three ingredients of war production—raw materials, machine tools and labour. He had the power to allocate by a single decision the whole of the raw materials which came into our possession either from the production of the Empire or by purchase from our Allies or from abroad. It would not be in the interests of production to tear the present organisation out of the Ministry of Supply. The detailed work of allocation would continue to be carried out by the Materials Committee on his behalf, and would henceforth be under the chairmanship of the Minister of Works and Buildings. The new programme for the production and importation of machine tools was in his control, and for this purpose the machine tool controller or someone at the same level would join Mr. Lyttelton's staff. The machine tools manufactured would be allotted on his decision to the various sections of the manufacturing industry.

The Minister of Production said that the most important part of his production would be that which he had designated the joint war production staff. The War Cabinet had approved the suggestion that he should set up a general staff of war production. He aimed to make this part of his organisation run on parallel lines to the main military organisation. This general staff of war production would be composed of his chief adviser on programmes and planning, Sir Walter Layton, the assistant chiefs of the staff to the three services, together with the highest technical officers of the three Production Ministries. The joint war production staff was to be served by a joint war production planning group composed of Naval, Army and Air Force officers and representatives of the Production Ministries working together in the same office. The object of the organisation was to ensure that production was closely and continuously related to strategical requirements, so that when the time came for strategical plans to be carried out, they could be carried out with equipment which was suitable for the task.

Skilled Engineers in the Forces

In the recently published report of the Committee on Skilled Men in the Services, it was stated that the Committee, at the request of the Service Departments, had invited a number of employers in the engineering industry and the engineering trade unions to furnish lists of men of certain skill formerly employed by them and now in the Fighting Forces, so as to bring these men under review by the Service Departments and ensure that, so far as possible, they were used on work in accordance with their skill. As a result of this invitation some thousands of names with relevant particulars have been transmitted by the Committee to the Service Departments and active steps have been taken by the latter to examine and deal with all cases in which there appeared reason for believing that the men's skill was not being used to the best advantage.

The invitation to employers was addressed in the first instance only to members of the Engineering and Allied Employers' National Federation. It is likely that numbers of men of engineering skill formerly employed in industries other than engineering, on maintenance and similar work, are now in the Forces and should be brought under review. The Committee announce accordingly that they are prepared to receive from any employers who have not already furnished such information, particulars of skilled men now in the Forces, who were previously employed by them in any of the following occupations: Blacksmith, boilermaker, coppersmith, electrician, fitter, metal machinist/setter-operator, millwright, moulder, patternmaker, plater, scientific instrument maker, sheet metal worker, shipwright, toolmaker, toolsetter, turner.

Particulars of men of other occupations, whether skilled or not, are not required. Nor should semi-skilled assistants to skilled men in the above occupations be included.

It is not the intention of the Committee to obtain release of men from the Service, but to ensure that tradesmen who are necessary for the maintenance and repair of fighting equipment in action are adequately used in their trade capacity. But every skilled engineer who can be found in the Services not adequately employed at his trade and available for transfer will save unnecessary withdrawal from industry of other skilled men.

The information asked for should be sent to the Secretary, Committee on Skilled Men in the Services, Queen Anne's Chambers, Westminster, S.W.1, and should include the man's Service number.

Less Tin for Bearings

Over 2,000 tons of tin annually, or nearly 10 per cent. of British consumption, finds its way into anti-friction (Babbitt) alloys for the lining of bearings. It is estimated that 65 per cent. of this can be saved if engineers, designers and others apply certain recommendations of a committee of representative makers and users who have been investigating the matter for the Ministry of Supply. It is pointed out that massive anti-friction linings on cast-iron shells can give place to thin linings on tinned steel or bronze shells, and this change can be made with a positive increase in load-carrying capacity. The best qualities of bearing metals, containing upwards of 85 per cent. of tin, are often specified, but now that tin is getting scarce, qualities containing much less tin should in many cases be used instead. Copies of the report may be had free from the Joint Controllers of Non-Ferrous Metals, Grand Hotel, Rugby, and the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Law Report

Lord Robertson gave judgment in the Scottish Court of Session in an action in which Mrs. Mary Austin or Hall, and her three pupil children, sued Stewarts and Lloyds, Limited, tube manufacturers, for payment of a total of £5,000 as damages in respect of the death of the husband and father, Thomas Renicks Hall, electrical engineer. In October, 1940, Hall was inspecting a fire-extinguisher for an overhead travelling crane in the moulding shop of a foundry at Coatbridge, when his head was struck by some portion of the moving crane, and he died the same day. His Lordship awarded to the mother £1,250 and to each of the three children £500. His Lordship held that the defenders' failure to provide a safe system of working caused the accident.

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The Week's News in Brief

Trade Talk

THE MINISTRY OF SUPPLY has taken over the control of all industrial diamonds. Sir Cecil Rodwell has been appointed Controller.

THE COST OF LIVING figure for February was a hundred points above the level of July, 1914, showing no change compared with January.

TWO MEN accused at Cardiff recently of being one to 4¼ hours late on various dates at their work as toolmakers, were each fined £10 and ordered to pay £1 11s. 6d. advocate's fee.

THE NUMBER OF MEN and boys registered in Great Britain as wholly unemployed at February 16 was 99,928, or 287 fewer than on January 12. Of the total 26,508 had been classified as unsuitable for ordinary industrial employment.

THE FOLLOWING have been elected to comprise the committee of the London Metal Exchange for the year beginning April 25:—Messrs. F. L. Baer, W. K. Davey, H. C. Street, O. Becker, R. S. de Poix, J. D. Wolff, W. J. Buchanan, W. E. Lucas, E. F. Woodbridge, F. C. Chisnall, P. W. Smith and A. S. Young.

ON THE LABOUR SIDE we are in a better position than Germany is at the present moment, said Mr. Ernest Bevin, Minister of Labour, in a speech. The demands on our man-power were still tremendous, but Mr. Bevin thought he could see daylight from the man-power point of view, even if the war had to be carried on for a long time yet.

THE ANNUAL GENERAL MEETING of the London Local Section of the Institute of Metals will be held at the Junior Institution of Engineers (Incorporated), 39, Victoria Street, Westminster, S.W.1, on Thursday, April 23, 1942, at 6.30 p.m. Following the meeting, Mr. H. G. Warrington will open a discussion on "The Utilisation of Secondary Light Metals."

TO STEP UP PRODUCTION to a maximum, part-time women workers are being engaged by Sheffield firms. Although the sources of full-time women labour are beginning to dry up, many employers are still prejudiced against part-time workers. Sheffield firms, however, are now showing that the scheme can work effectively, and more and more married women with only half a day to spare are being taken on.

THE ANNUAL REPORT of the Sheffield Chamber of Commerce states that the taxation committee have strongly criticised the effects of the Excess Profits Tax, and, through the Associated Chambers of Commerce, have renewed representations to the Chancellor of the Exchequer. The report suggests that the tax should be 80 per cent. instead of 100 per cent., and that repayment of 20 per cent. after the war should be obligatory.

A DEPUTATION FROM THE T.U.C. General Council has discussed with Mr. Herbert Morrison at the Home Office revision of the workmen's compensation system. The deputation pressed that the Government should undertake a complete overhaul of the system, and referred particularly to such questions as the medical arrangements, the computation of average weekly earnings, the position of the partially incapacitated workman, and the provision for treatment and rehabilitation of the injured workman.

SHEFFIELD'S GIFT CASKET for Stalingrad—the Russian steel city—and a £2,000 cheque for the National Council of Labour Fund for Russia were handed in at the Soviet Embassy in London recently. The casket is made of stainless steel, and holds a greetings book with 10,000 signatures of representatives of all sections of the community. The £2,000 cheque was raised by collections among the Sheffield employees of the English Steel Corporation, Limited, and includes a substantial donation from the management.

"THE GRIFFIN," the ironfoundry of Hunt Bros. (Oldbury), Limited, has collected nearly £3,000 among its workpeople, equal to £20 per man employed at the works, in Oldbury's Warship Week. By a coincidence, the town has adopted the destroyer "Griffin." Also, since the Savings Campaign started, savings at the Griffin Foundry have never dropped much below 20s. per man per month; a total of £8,700 has been invested through the Group, and income-tax has made no appreciable difference to the amount being saved each week.

EVERY IMPORTANT ENGINEERING FACTORY will have its Joint Production Committee as the outcome of an agreement reached between the engineering employers and the unions. The agreement provides that each committee shall consist of not more than 10 from each side. The workers' representatives will be elected by ballot conducted jointly by the management and the union representatives in the shops. The management will appoint the chairman, and each side will appoint a secretary. The agreement is between the Engineering and Allied Employers' National Federation on the one side, and the Amalgamated Engineering Union, the National Union of Foundry Workers, and the Confederation of Shipbuilding and Engineering Unions on the other. While the agreement applies primarily to all factories employing not fewer than 150 workpeople, it is suggested that joint committees should also operate in smaller concerns.

Personal

MR. H. J. S. MOYSES has been elected a director of the Birmingham Small Arms Company, Limited.

MR. A. M. BAER has been appointed a Joint Controller of Non-ferrous Metals in place of Mr. J. C. Budd, who has resigned on grounds of health.

MR. C. V. APPERSON, joint managing director of C. T. Skelton & Company, Limited, tool makers, Sheafbank Works, Sheffield, has completed 50 years' service with the firm.

MR. WILFRID AYRE was elected president of the Shipbuilding Conference at the annual general meeting, held in Edinburgh on March 20, in succession to Sir Maurice Denny, Bt., who had completed two successive years in that office. Mr. Ayre is chairman and managing director of the Burntisland Shipbuilding Company, Limited. Sir G. Tristram Edwards, joint managing director of Smith's Dock Company, Limited, South Bank-on-Tees, has been elected vice-president of the Conference.

OLD TIMERS will be pleased to hear that we have had a letter from Mr. "Bob" Mason, of Southwark, South Australia, a founder of the Institute of British Foundrymen, and the septuagenarian proprietor of the largest steelfoundry in South Australia. He operates a two-ton capacity Greaves-Etchells furnace and a small converter, the two giving a production of 130 tons a month. He is associated in his business with Mr. D. C. Cox and his two sons, Mr. John Mason, who acts as works manager, and Mr. Robert Mason, Junior, the works metallurgist. The firm operates a subsidiary concern, Mason & Cox, in Melbourne.

Wills

MACKAY, CHARLES, of Handsworth, brassfounder ...	£6,708
PRIESTMAN, SIR JOHN, of Sunderland, shipbuilder	£1,299,539
WESSON, MAJOR J. S., of Tettenhall, Staffs, steelworks director	£87,557
GREEN, H. E., of Shenfield, Essex, managing director of Murex, Limited	£219,088
HEYWOOD, S. D., engineer, a director of R. & J. Dempster, Limited, Manchester	£51,451
MULHERRON, G. F., of Torquay, managing director of the former Tyne Iron Shipbuilding Company, Limited	£43,853
LEDINGHAM, L. N., of Sheffield, chairman and managing director of L. N. Ledingham & Company, Limited, steelmakers	£40,444
FIRTH, F. W., of Sheffield, chairman of the Brightside Foundry & Engineering Company, Limited, and associated companies	£75,711
ROWELL, R. S., of Leatherhead, Surrey, a director of R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-upon-Tyne ...	£32,183

Obituary

MR. HENRY MACPHERSON, who has died, aged 72, at Leeds, was formerly assistant managing director of the Wellington Foundry, Leeds, of Fairbairn Lawson Combe Barbour, Limited.

MR. T. H. KNEEBONE, a well-known figure in the local mining industry, died at Barrow recently at the age of 62. He commenced his mining career with the Barrow Hematite Steel Company, Limited, at Park Mines at the age of 13 years.

MR. R. PERCIVAL SMITH, a director of Steel, Peech & Tozer, and general works manager of the company's Ickles and Templeborough works, Rotherham, died on March 19, after a short illness. He had been associated with the firm since 1928. He was born in Edinburgh, and educated abroad; joining the Lanarkshire Steel Company in 1908, he went to Colvilles, Limited, Glasgow, in 1920, remaining there for eight years.

MR. LLEWELYN WYNN-WILLIAMS, who died last week at Darlington, in his 69th year, was managing director of Llewelyn Wynn-Williams, Limited, railway engineers, Haughton Bridge Works, Darlington, an enterprise which he founded some 20 years ago. He graduated at Glasgow University with the B.Sc. degree in engineering and his earlier business career was spent in association with his father, the late Mr. Henry Williams, as a manufacturer of railway appliances.

MR. DAVID K. GLASS, formerly general manager of the Clyde Ironworks of Colvilles, Limited, died recently. Mr. Glass, who started his career with the Carron Company, was an authority on coke-oven and blast-furnace practice. After the last war he joined James Dunlop & Company, Limited, and was retained as chief engineer when the steel interests of that company were merged with Colvilles, Limited. He was actively concerned with the development of Cardowan colliery and with the planning and erection of the hot-metal plant at Clyde Ironworks.

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Hunsbury Machinery—£10,000. J. R. Fisher, 136, Allcroft Road, London, N.W.5, subscriber.

Fabriweld—Welders, etc. £1,000. W. S. Williams, Hazeldene, Pentyla, Aberavon, Glam.

John Bailey (Founders)—£100. J. Bailey, 3, Wilworth Crescent, Blackburn; H. R. Heatley and H. Graham.

Miles Compton—Founders, engineers, etc. £1,000. E. and M. B. Crompton, 89, Copster Hill Road, Oldham.

A. D. Davidson Industries, 83, Angelina Street, Birmingham—Metal spinners and workers, engineers, etc. £1,000.

E. W. Wynn (Ironfounders), 46, Cherry Street, Birmingham, 2—£5,000. E. W. Wynn, S. E. Wynn and F. W. Robinson.

Ratzer & Hampton Tools—£2,000. J. H. W. Ratzer and D. B. Hampton, 53, South Croxted Road, London, S.E.21.

Colne Industries—Founders, engineers, etc. £1,000. G. E. Rawlings, 12, Stanhope Avenue, London, N.3, subscriber.

S. H. Hannah, Coronation Road, Selly Oak, Birmingham—Electric control gear makers, etc. £3,000. S. H. and E. N. Hannah.

Coton Foundry & Engineering Company, The Bull Ring, Chilvers Coton, Nuneaton—£2,500. T. I. and H. I. Sanderson.

Chasbur, Speedwell Road, Hay Mills, Birmingham—Metal merchants, founders, etc. £1,500. C. N. and C. C. M. Burley.

Rainville Engineering Company—£5,000. J. C. im Thurn & Sons, Limited, 14, Finsbury Circus, London, E.C.2, subscribers.

T. Witta—Ironfounders, engineers, etc. £1,000. T. Witta, 70, Shap Street, Kingsland Road, London, N.; and A. Bloom.

Valley Components—Machinists, engineers, etc. £3,000. H. R. Head, 41, Haden Park Road, Old Hill, Staffs; B. M. Farrell and E. Wyatt.

Barnes & Hacker—Tool makers, founders, engineers, etc. £10,000. E. G. Barnes and F. C. Truman, 56, Morland Road, Great Barr.

Dagenham & District Engineering Company, Crown Works, Rainham Road South, Dagenham, Essex—£1,000. C. Monk, J. Monk, H. S. Smith and R. Davis.

Gulstad, Pilling & Graham, Allbrit Works, Brown Street, Littleborough, Lancs—Ironfounders, engineers, tool makers, etc. £2,000. H. C. Gulstad, J. Pilling and I. Graham.

Hardenlast—Manufacturers of and dealers in materials for hardening, treating and processing metals, etc. £10,000. F. L. Sneed, 3, Fairland Avenue, Buckhurst Hill, Essex, subscriber.

George W. Rawlings & Partners—Manufacturers of and dealers in tools and machinery, etc. £2,500. G. W. Rawlings, Willow Meer, Park Hill, Kenilworth; I. M. Rawlings, H. R. Burgess and F. Holmes.

Contract Open

Glasgow, April 10—Bolts and nuts, brass cocks, cast-iron pipes, iron castings, steel files, etc., for 12 months from June 1, for the Corporation Gas Department. The General Manager, Gas Department, 30, John Street, Glasgow, C.1.

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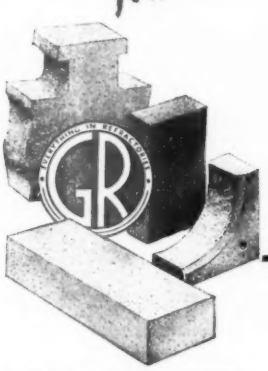

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Raw Material Markets

Ample tonnages of high-phosphorus iron continue to be available and demands are steadily increasing, as consumers who would normally use better qualities, if they were in more plentiful supply, are now taking this grade. The Iron and Steel Control are pressing consumers to utilise as much high-phosphorus iron as possible, as it is produced from home ores, whereas the manufacture of other grades requires imported ores, shipments of which must be restricted to the bare minimum. Hematite is particularly difficult to acquire at present, although output is at the maximum level.

Pig-Iron

MIDDLESBROUGH—Output of ordinary foundry iron on the North-East Coast is negligible; all the furnaces are in operation, but they are needed to produce iron required by the steel plants. Very large tonnages of basic iron are being delivered to the steel industry, and practically all the available supply of hematite is under immediate requisition for essential needs. Refined iron is being produced on a satisfactory scale, but there is no surplus after urgent demands have been met. Demand for ordinary grades of foundry iron is quite strong, and Cleveland consumers are placing orders with makers in the Midlands, who are able to deliver without undue delay. Prices charged for high-phosphorus iron from the Midlands are the same as those fixed for locally produced material, so that the longer haulage costs have not been passed on to the consumer.

LANCASHIRE—Textile-machinery makers, light-castings and jobbing founders are not enjoying very active business, and their requirements of foundry iron are below the average level in normal times. There are few indications at the moment that there will be any material improvement in any of these sections for some time to come, as there is little business of national importance which can be offered to them, and their normal outlets have largely been sacrificed as a measure of economy, the raw materials being needed for other uses closely associated with the war effort. Adequate supplies of foundry iron are on hand, and producers in the Staffordshire and Derbyshire areas are able to deliver all the iron ordered. The position of speciality engineers is much healthier and they are mostly employed to capacity on important contracts for Government departments. Supplies of hematite and Scotch iron are not as plentiful as might be desired, while the distribution of refined qualities has been further tightened up. Consumers are urged to use as much high-phosphorus iron as they can, as large quantities of this grade can be procured.

MIDLANDS—General and speciality engineering establishments are in possession of well-filled order-books, and many of them cannot accept fresh business over some time ahead. Most of the orders for these concerns emanate from Government bodies and are of an urgent character. The position regarding makers of light castings is quite different; these firms have not been able to secure sufficient Government work to counteract the steep decline in normal outlets, as their plant, generally speaking, is not easily adapted to cope with the heavier castings which are required in the main by the various official buying agencies. Large quantities of high-phosphorus iron are forthcoming despite the big expansion in consumption in the heavy engineering section. Low- and medium-phosphorus grades are fully taken up, while refined iron is also used extensively. The trend of late has been to incorporate substantial tonnages of steel scrap.

SCOTLAND—Heavy engineers generally are very busy, and their raw material requirements are on a large scale. On the whole, their needs are being readily satisfied, although they are not getting the grades to which they are accustomed in many cases, and are being urged to make every possible use of high-phosphorus iron, supplies of which are adequate. Orders placed with light-castings makers continue to be rather more plentiful, but there is still room for improvement in this department.

Coke

Coke continues to be delivered to foundrymen satisfactorily, and there are no complaints of shortages. Consumption is considerable, but the make is easily able to look after all demands. For delivery to Birmingham and Black Country stations, the current quotation for Durham best foundry coke is 62s. 9d. per ton, this being the minimum price fixed by the Control.

Steel

Many steelworks have substantial stocks of shell-discard steel on their hands, and it is hoped that steel users will take up as much of this material as possible; it can be used for a variety of purposes, and pressure on other descriptions could be appreciably relieved. Manufacturers of joists, sections, etc., are moderately well placed, and quite a fair amount of business has already been booked for the second period of the year, although most of the works are open to receive additional orders. Plate mills have full order-books extending over some time ahead. Special sheets for Government purposes are very active.

Scrap

Some qualities of scrap continue to be tight, but so far essential users are having their immediate needs covered. Better supplies are reaching ironfoundries than the steelworks in proportion to their demands, but every effort is being made to expand the quantity of old metal suitable for steel-making purposes. Railings and other scrap metal arising out of the national collection campaign are coming to hand faster than they can be dealt with by the reduced labour forces. Light cast-iron scrap is particularly plentiful.

Metals

TIN—The cutting out of non-essential consumption of tin continues to be pursued vigorously; consumers engaged on important orders are receiving ample supplies to cover their requirements. According to the Tin Research Institute, Japanese control of Far Eastern supplies has reduced world tin supplies to 78,000 tons a year, against a wartime need of 175,000 tons. The Institute point out that restriction must be applied swiftly but skilfully to avoid dislocation to industry.

In the House of Commons on Thursday the Financial Secretary to the Treasury (Capt. Crookshank), replying to questions addressed to the Chancellor of the Exchequer, clarified the liability of British registered companies in Malaya to E.P.T. and income-tax. He said that if these companies continued in being with the intention of resuming operations in Malaya as circumstances permitted, they would not be treated as having ceased business, but would be treated for taxation purposes as still carrying on trade. As regards Excess Profits Tax, therefore, they would be able to avail themselves of the provisions under which deficiencies could be set off against E.P.T. already paid. As regards income-tax, they would continue to be assessable on the basis of the preceding year's profits.

The American Bureau of Metal Statistics reports that consumption of primary tin in the United States in 1941 amounted to 99,380 tons, against 74,114 tons in 1940, 69,041 tons in 1939, and 50,624 tons in 1938. The individual items of consumption in 1941, compared with 1940, were as follow:—Tinplate, 48,700 (38,964) tons; babbitt, 5,870 (4,120); solder, 18,420 (11,430); bronze, 9,870 (5,530); collapsible tubes and foil, 4,720 (5,370); other uses, including terneplate, pipe, white metal, alloys, castings, tinning copper sheet and wire, oxides and chlorides, and miscellanies, 11,800 (8,700) tons. The domestic production of pig-tin from resmelting by-products of the makers of tin and terneplate and the recovery by detinners does not enter into the above accounting, for the reason that the use of such tin has already been credited to tinplate and terneplate.

The establishment of a tin-smelting plant in South Africa is being considered, and it is understood that a complete scheme for its erection has been submitted to the South African Minister of Mines. The need for a smelter in the Union has long been recognised. South Africa has several promising tin-bearing areas and a few producing mines, and it is suggested that if a tin smelter could be established tin output could be materially expanded. Events in the Far East have brought the matter to the forefront, and it is thought that the highly trained staff necessary could be procured from the experts formerly employed in territory now occupied by the Japanese. Durban has been suggested as the most suitable site for the proposed plant. Tin mining is actually one of South Africa's oldest industries, tin being extensively mined before the first Europeans arrived on the sub-Continent. In 1905, ancient workings of the Rooiberg tin mines were rediscovered, and since that date tin mining has been carried on more or less continuously. Annual production of concentrates reached a peak of 3,441 tons in 1915, this figure being rather more than four times the total output of 1939. During the last war, the smelter of the Zaaiplaats Tin Mining Company, Limited, which smelts its own concentrates, began smelting tin for consumption in the Union. The venture proved to be successful during the war period, but was discontinued in 1921. Smelting was also carried on at Leeuwport during the last war, but was abandoned soon after and re-introduced for a short period in 1922, when low-grade concentrates were smelted. The value of the metal produced was £68,000. The economical smelting of tin in South Africa during the last war was made possible by the disparity between the Straits price and the price on the London market, which, in 1918, was as much as £32 8s. 6d. per ton. Over a period of 12 months from the middle of 1918, 500 tons of concentrate were smelted and the bulk of the resultant refined metal sold in London. It is now urged that, from an economic standpoint, the proposed tin-smelting plant hardly seems to be warranted, though strategic factors favour the proposition.

COPPER—No details of imports of copper are available, but there is every reason to assume that cargoes are arriving regularly, as adequate tonnages are being released for all important purposes. Ordinary domestic users, of course, cannot acquire more than a fraction of their normal supplies. The American Copper Institute announces that in 1941 1,567,216 short tons of copper was consumed by fabricators in the United States, compared with 958,187 tons in 1940. Deliveries by producers to fabricators were 1,513,292 tons, against 1,001,886 tons. The total stocks and undelivered purchases held by fabricators at the end of last year amounted to 242,793 tons, a fall of 186,126 tons from the figure at the end of 1940. Unfilled orders, on the other hand, rose from 413,388 tons to 547,468 tons during 1941, and whereas at the end of 1940 fabricators had stocks and/or purchases of 15,351 tons in excess of unfilled orders, at the end of 1941 their stocks were 304,675 tons less than their unfilled orders.

SPELTER—Brassmakers are using high-grade zinc on a very large scale, but the supply seems to be satisfactory. In fact, war factories generally are being kept fully supplied with spelter; this is largely due to the big cuts which have been made in allocations to non-essential users.

LEAD—The lead position remains satisfactory in so far that the volume of metal available for Government work is substantial. Distribution to other potential buyers, however, is carefully controlled.

The American Bureau of Mines announces that in 1941 the apparent consumption of lead in the United States increased by 25 per cent. over 1940 to reach record proportions. Of the quantity used last year a higher proportion was from foreign sources than probably since the establishment of the domestic industry. An increase of nearly 60 per cent. in imports of refined lead is indicated for 1941 over the previous record year of 1940. Reports from producers covering eleven months' actual production plus an estimate for December last indicate that 584,100 tons of refined lead was produced during the year.

S-Curve of a Chromium-Nickel Steel

The S-curve of a chromium-nickel steel has been studied by Blake M. Loring in the course of a Paper to the American Institute of Mining and Metallurgical Engineers. A curve was constructed for an oil-hardening grade, and an extremely slow rate of reaction for the lamellar transformation was found at 510 deg. C. The transformation was studied by several methods, including hardness measurements, dilatometer observations, and micro-examination. The dilatometer observations gave evidence of what has been called a two-stage reaction in the low-temperature transformation of austenit